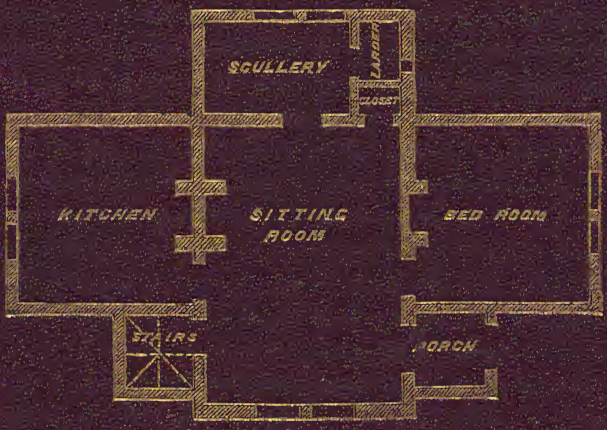
Practical Architecture



for Farm Buildings, &c.

1971 CA

R. E. Cochrane
1878.

Practical Architecture

AS APPLIED TO

FARM BUILDINGS OF EVERY DESCRIPTION (COW, CATTLE AND CALF HOUSES, STABLES, PIGGERIES, SHEEP SHELTER SHEDS, ROOT AND OTHER STORES, POULTRY HOUSES), DAIRIES, AND COUNTRY HOUSES AND COTTAGES.

PROFUSELY ILLUSTRATED WITH DIAGRAMS AND PLANS.

By ROBERT SCOTT BURN,

Farm Architect and Engineer,

Author of "Landed Estate Management," "Outlines of Modern Farming," and various Agricultural Works.

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Practical Architecture.

PART I.—BUILDINGS FOR FARM STOCK.

Introduction.

The directions which will be found in the following pages on the subject of the various apartments which go to make up a farmery, or farm steading, could scarcely well, or practically, be commenced without some notice, however brief, being taken of the general principles which guide the designer in arranging those as a whole. For, however important the arrangement and construction of such apartments as separate structures may be, it is obvious that there must or should be a relationship which they bear to one another, according as this be well or ill followed out, tending materially to add to, or detract from, their utility when arranged as part of a general system.

This relationship is in fact of the highest importance, and must be carefully considered in all cases where economy in the working of the farmery is desired; for, in a certain sense, a farmery is like a factory, in which one part has such a close dependence upon another part, that, unless the two are worked together, so that no time shall be lost, or labour expended needlessly, loss of both will be sure to be incurred.

In fact the apartments should be so placed that the work done in one may have a natural relation, so to put it, to the work done in another; that there may be no time lost in "returning upon one's self," as has been remarked; that, as there is in each department of the work to be done on a farm, a natural sequence of operations, so the apartments in which this work is done, and those operations carried on, should be placed one to

another, that the work will go through from one apartment to another regularly; thus, in the case, say, of the dairy stock and the dairy. Cattle all requiring much straw, the apartments or parts in which they are housed shall be so placed with relation to the barn in which the straw is stored, that the straw shall be carried to the stock in the quickest possible time; that after the straw has been converted into manure, that that manure shall be in the same speedy fashion conveyed to the dung heap. Again, as the dairy stock require certain foods other than straw, the apartments in which these are stored should be as near as possible to the cowhouse; but as in modern farming cooking and other preparatory processes are gone through before the cattle receive the food, the apartment in which these processes are carried on must be between that in which they are stored and the cowhouse in which they are consumed. Take again the stable—hay here is largely used as well as straw and other artificial foods. The hayhouse must, therefore, be near the stable, and the food store also, and the cookery room for mashes also be placed in relationship to that in which the materials are kept. In the cattle courts turnips are largely used; turnip stores must be near the courts, and so on.

But, while convenience of working and economisation of time are secured by placing the apartments in proper relationship one to another, it is necessary, in order not to throw away means unnecessarily, and complicate an arrangement which might be comparatively simple, that only such of those apartments, or structures containing them, be put down to suit the peculiar style of farming adopted. In other words, the factory must be arranged and have only such apartments and conveniences as are required to carry on the business for which it is designed and constructed. Common sense would seem to dictate that this principle would be carried out in designing farmeries or steadings; but that it has not always been so carried out, is patent to those who have had and have an intimate knowledge of the plans which have been suggested from time to time. The cause of this is in many instances the forgetfulness of the designer that there is not one universal style of farming only carried on in this country, but many styles, each of which has its own characteristics, requiring modifications in the plans. This is not the place to enter into a discussion or statement of the various styles of British farming. These the reader, if so desirous, will find in the "Book of the Farm"* fully and clearly explained; suffice it here to say

* The Book of Farm Buildings: their Arrangement and Construction. By Henry Stephens, F.R.S.E. (author of The Book of the Farm) and Robert Scott Burn, illustrated by plates and woodcuts. (William Blackwood and Sons, Edinburgh and London.)

that the style of farming, the buildings of which best illustrate the principles of arrangement, which we have but just now, in a very brief and general way described, is what is known as the "mixed husbandry farm." This embraces within its scope nearly every kind of farming. On farms of this kind grain and a wide variety of crops are grown, cattle and sheep bred, reared, and fattened for market, dairy produce made, as butter and cheese, and milk produced by dairy cows for the same, pigs, poultry, and pigeons, are kept. All this necessitates the having of land to a considerable extent, four to five hundred acres being at least the quantity needed to do ample justice to its requirements. Embracing such a wide variety of farming operations, the system of mixed husbandry is therefore, obviously one well calculated to afford an illustration of principles of arrangement which will be found applicable not to all, for that is obviously impossible, but to a wide range of examples suited for many localities.

And here at this point should properly come in remarks upon position of the farmery with relation to the fields of the farm, the influence of rocks, state of the ground, level or otherwise, upon that position, the site, its soil, aspect, supply of water, &c. All these, however, we must pass over from lack of space here, and confine our concluding sentences to the subject of arrangement only.

Taking the various isolated structures which, as isolated, we shall illustrate and describe further on, they may be arranged so as to form a whole on three different methods: first, what we may call the "compact;" second, the "grouped;" and third, the "isolated" or "detached" system. In the first the whole of the apartments required to make up the farmery—and these will be regulated in style and number according to the mode of farming adopted—are built one after the other, one apartment coming close up to another, so that there is a continuity of "walling" and "roofing" throughout. In the second system, the "grouped," the various apartments are placed, as the name denotes, in groups, one set being placed at one part, another set at another part, spaces or intervals, greater or less according to circumstances, being left between them. It is obvious that these two systems may be used in combination. In the third system—the "isolated" or "detached"—while the greater number of apartments would be placed under one or other of the two first systems, there are isolated buildings, such as barns or cattle or stock houses, at parts of the farm, more or less distant from the central buildings. This last is only used on very large farms.

In these three systems—and in some respects they ought to be reduced to two, the first forming one, the third another—the mode of arranging the separate apartments, so far as we have gone, remains untouched, and

has yet to be considered; for it is obvious that each is capable of being modified in any way, and to any degree, this modification being dependent entirely upon two points—first, the style or mode of farming, and second the opinions which the designer may have.

And, first, as to the "compact system." We have stated that the leading feature in this is continuity of walling and roofing, arising from the whole of the apartments being built so as to join one up to another. This system has its advantages, and likewise its disadvantages. As to the first, it may be said to be the simplest, if not the most economical, method of building. By arranging the whole apartments in the form hereafter to be illustrated, the walls and roofs can be made without a "break" in their whole length; and, as we shall show when treating on cottages, farmhouses, &c., this permits of the cheapest style of roof constructed; and, as we shall there also show, the most expensive part of buildings is the roof. Considerable economy is effected by the adoption of this system. Again, the whole of the work can be carried on continuously without involving the necessity for going into the open air. On the other hand, the system possesses the great disadvantage of being the best adapted to promote the ravages of fire should that ever break out into any one part. This will be obvious from the nature of the construction. Much, at least something, can, however, be done to mitigate the evil by carrying up the partitions to the roof line. These will form a series of solid parts, which will help to confine the fire to one part; or one or other of the fireproof systems may be adopted, from which a still higher degree of security from fire may be obtained.

Looking now at the second or "group" system, we perceive at once that the disadvantages last named do not apply, to anything like the same extent, inasmuch as there are spaces of considerable extent between one group or division of buildings and the other. And those spaces will help materially the attempts to extinguish the fire, should it break out at any one part, by confining it to that part. Again, in the case of disease breaking out amongst the stock, the system admits of an isolation which will be found very useful in helping the farmer to arrest its progress by keeping particular stock apart from each other. On the other hand, there is this disadvantage attendant upon the system, that it is more expensive to construct, so many different parts requiring each its own individual or independent roofing. Again, unlike the first system, the whole of the work cannot be carried on continuously without the attendants coming at times into the open air. This with farm labourers is indeed no great matter, and with many will not be deemed at all worthy of any consideration; but it is not merely this which is involved,

but what is of greater importance—the loss of time incurred by going out of one building to reach another.

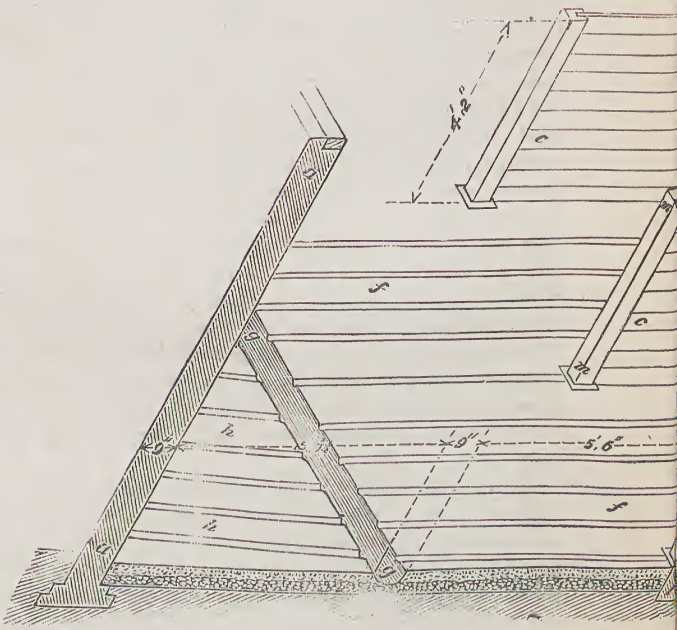
As regards the third system, it may be remarked that where apartments are placed at distant parts of the farm as cattle houses, to save the loss of time and other inconveniences incurred by bringing those animals up to the main buildings which are to be housed and fed there; the time saved in this way is to a certain extent lost by the men having to go down to the animals. This having to be done at least twice in the day, and this at early and late hours, may involve inconveniences, which may be greater than the conveniences gained otherwise. And it is questionable whether it is a good plan to have valuable animals kept at a distance from the main buildings, where close supervision cannot at all times be given to them; where their wants and their complaints cannot at once be attended to; and, moreover, to the isolated distant stock houses, it must be remembered that food, either prepared or in its natural state, must be carted from time to time. In the case of barns for the storing up of field produce, the same remarks do not apply with such force. These isolated corn barns of course involve the necessity of employing a portable steam engine to thrash out the grain; and this, when thrashed, ought to be taken up to the main buildings, to be stored up in the granaries there. That the system, on a small scale, can be usefully employed on large farms there can be no doubt; but on the large scale we believe that it is not so well adapted to economical practice. When we say "large scale" we refer, of course, to the buildings themselves, which are erected here and there at the different points required. With regard to the stacking and the thrashing of grain in outfields, we confess to having no high opinion of the system, preferring the old plan of having these done at the main buildings; and it is only during exceptional seasons and under extraordinary circumstances that we should carry it out.

In this little handbook which we have been privileged to present to our readers, on a subject of great importance and undoubted interest to he agricultural community, neither have the limits of its scope, or the principles of the scheme upon which it is based, admitted of our giving an exhaustive treatise; but we trust that we have given a number, and in that number a variety, of remarks which may serve at least as hints and suggestions, from which something of value, which the practical, no less than the general reader, may be able to make available and suggestive. It is impossible to please all tastes, to come up to the standard of all requirements; he who attempts to do so will find himself in the position of the man in the well-known fable; but, nevertheless, we may be permitted to express the hope that the pages which have been

given us to fill have not been filled altogether in vain; and that by some, if not many, they will now and then be consulted, and consulted with some practically useful and suggestive results.

Dairy-Cow Houses.

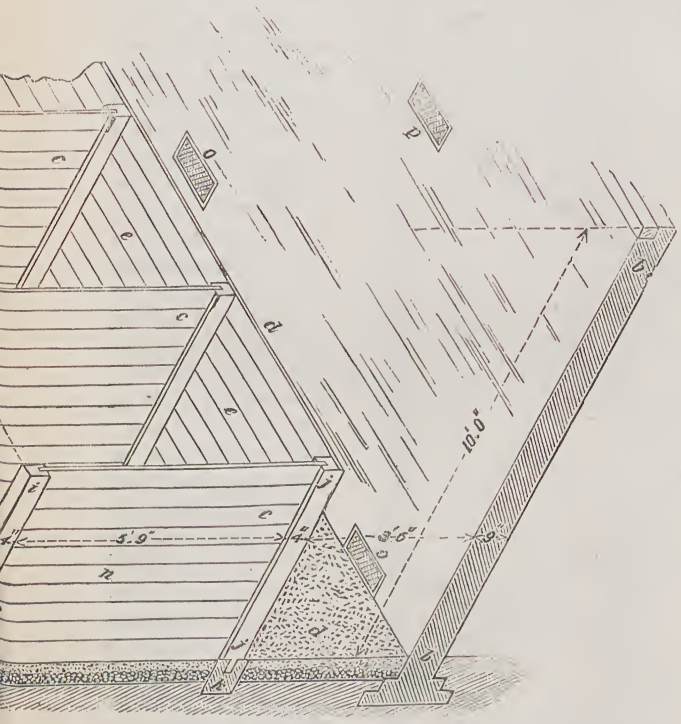
THAT there is a way in which the Buildings we use for the housing of farm stock may be arranged and constructed so that we can secure for the



Fig

animals a fair chance that their health may be maintained, as far as these can maintain it, and another way in which the buildings will exercise a positive influence of a deleterious character, is perhaps, after all, but the statement of a truism; but if it be so, it is one too often overlooked, if one may judge by the evidences everywhere and on all sides to be met

with. Nor, if "laws" exist which are daily in operation, and which have, in that operation, a close bearing upon the health of the animals, do we find much evidence around us that these laws are recognised and believed in, so seldom do we see them cared for, or thought of. The very diversity, in fact, which we have noticed above as observable in the details of buildings, is a proof of this; for if "laws" exist, like other laws, they will act in a way the results of which may be fairly predicated, and these results will be the same, or nearly the same in all cases, making



reasonable allowance for such variations as certain peculiarities of locality and the like may bring into action. Attempts have been made, but they have been few and far between, to draw attention to the laws of health which affect our domestic animals, these bearing upon the structures in which we house them; but there has been, as the result of this,

no complete and systematic code of rules or plans devised which could be made easily applicable to every-day practice. Some of the points, so far, indeed, from being in the position of being definitely agreed upon, constitute to-day some of the "vexed questions" of agricultural practice, adding unfortunately to the already too long list with which the science is blessed or—the "other thing."

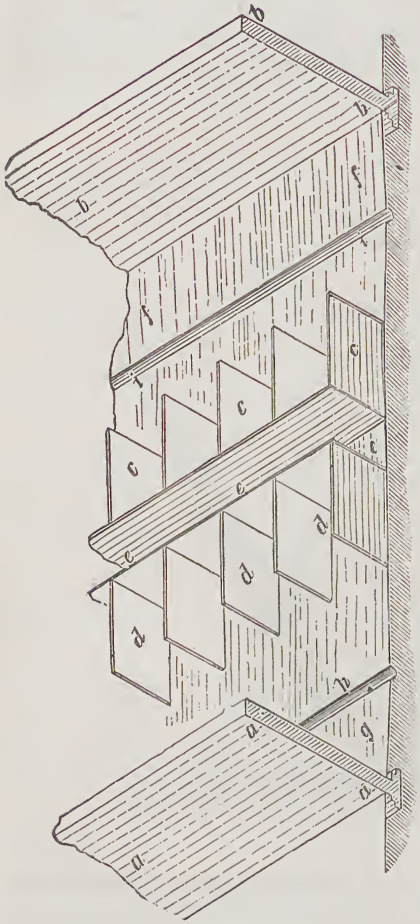


FIG. 2.

It would be well if some able authority were to devote his attention to the whole subject; and it would be better still if this were done under the auspices of one or other of our wealthy and well-to-do agricultural societies. For truly hopeless to us, with our experience of such matters, does it seem, to look for such "able authority" being repaid for his labours by any "return" made in the way of extensive purchase of such work as he might devote to the subject; well done it would be well spoken of, studied by a select few, bought by a class more select and fewer still in point of number. The difficulty would be to find in any one individual the rare combination of ability and experience required to do justice to such a work or paper as we have here suggested, the knowledge—physiological, agricultural, and architectural—and, to make a wretched pun, all the

"alls" required. Hence another reason, we opine, for a society taking the subject up and treating it in its entirety. That the subject is of vast importance to us nationally there can be no doubt whatever, if we only consider one point out of many connected with it, namely, the loss we yearly sustain through the sickness and death of our farm stock; these arising from causes which are said to be easily preventible. Some authorities estimate this loss at no smaller a proportion than one-tenth of our whole stock, others at a much higher figure. Surely, if the loss by this decimation of the animals we depend upon to feed our population *can* be prevented it ought to be; and it is surely not beneath the dignity, as it is assuredly within the limits of the utility, of our great societies to inquire how this "can" may be realised. To anyone at all conversant with the practice of farming throughout the kingdom, and knowing fairly the wretchedly low scientific condition in which much of that practice exists, there can be no doubt, whether it be true or not, that so large a proportion of loss is brought yearly about by causes which could be obviated, it is abundantly evident that the loss must be very large. In many districts we know of, we have no difficulty in singling out in each of them instances, striking if not numerous, of a large amount of loss arising from gross neglect or ignorance of what may be called the ordinary rules of good scientific farming; and whether this arose either from the one or the other, neglect or ignorance, the unfortunate practical fact remains still the same that the loss was brought about. Our readers, we are assured, will have no difficulty in adding from the range of their experience facts to bear out what we have said.

These remarks are not, we believe, out of place in preceding an attempt to bring together in a few chapters several points connected with the healthy maintenance of farm stock in the buildings designed for the different varieties of animals.

And first, as to the arrangement of the cowhouse, shippon, or byre, for by all these names is this part of a farmery known. The arrangement of the stalls in the cowhouse varies according to circumstances. Much depends upon the size of the house, or rather the number of cows to be kept in it. For small houses, where from four to eight or twelve are to be kept, the arrangement shown in Fig. 1 is probably the best. This drawing is made to a large scale purposely to show the nature of the fittings, these being fully described afterwards; but it forms one of the three illustrations—Figs. 1, 2, and 3—designed to show the different methods of arranging cattle houses in use in modern farming. In Fig. 1, *a a*, *b b*, are the front and back walls, *c c* are the divisions—technically called "travises"—between the stalls. In old-fashioned houses—and indeed we may say the same of many recently-erected ones—the heads of

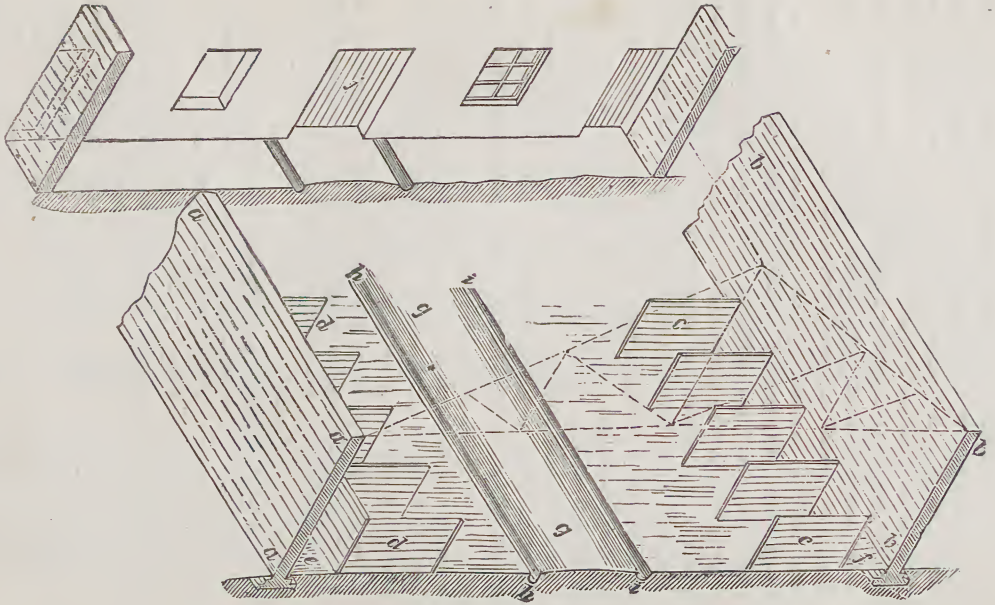


FIG. 3.

these divisions come right up to the back wall, *b b*; but in the modern system there is a space, *d d*, left between the back wall, *b b*, and the heads, *e e*, of the stalls, *c c*. This space is termed and used as the "feeding passage," the food being trucked or carried along the passage, the mangers in the stalls being filled by the attendant. There can be no doubt that this method of supplying the mangers and stalls from an independent passage is a good one, inasmuch as it enables the animals to be fed without going in amongst them while in their stalls and thus disturbing and annoying them. The advantages to be derived both in the case of dairy cows and fattening cattle, stall fed, from keeping them quiet are such that all good feeders endeavour to secure them; and this is the reason why the feeding passage system is a good one, independent of the cleanliness and order which it also secures. Between the floor space, *f f*, in front of the stalls, is the "cleaning" or "dunging" space, *h h*; in front of the wall, *a a*, lies the "gutter," *g g*. Such is one method of arranging the stalls of a cowhouse. Another is shown in Fig. 2. In this *a a* is the front, *b b* the back wall; the stalls, *c c*, *d d*, are placed near the centre between the two walls, but have their heads separated by a "feeding passage," *e e*; the dunging passages are on each side of the building, as at *f f* and *g g*, *h h* and *i i* being the "gutters." The third and last method of arranging the stalls is illustrated in Fig. 3, *a a* being the front and *b b* the back walls. The method may, in fact, be said to be a duplicate of that illustrated in Fig. 1, the stalls, *c c*, *d d*, being placed in rows, in front of both the back wall, *b b*, and front wall, *a a*; feeding passages, as *e*, *f*, being given at the head of each row of stalls. The dunging passage, *g g*, is placed in the centre of the building, being bounded on each side by the gutters *h h*, *i i*. The methods in Figs. 2 and 3 are best adapted for large cowhouses; and of these two that in Fig. 3 will be found perhaps the best in practice. Of the method in Fig. 2, it may be said that it possesses the advantage of possessing a central feeding passage, *e*, from which the mangers can be filled, right and left, very quickly; whereas, in the arrangement in Fig. 3, the feeding has to be carried on in two feeding passages, *e* and *f*. On the other hand, it must be noticed in favour of the arrangement in Fig. 3 that, from having a central dunging passage, as *g g*, the dunging can be done very quickly right and left, and the dung carried off at one operation through the central dunging door, *j*, in the end wall of the building. The decision in favour of one over the other of these two methods in the case of large houses will possibly rest upon the point as to whether the proprietor wishes the dunging or the feeding of the animals done with the greatest quickness. Both are most important operations in the work of a farm, and it is hard to say which of the two requires to be most quickly performed. Both methods of arrangement

possess advantages which that for smaller houses, shown in Fig. 1, does not possess.

Having now illustrated and briefly discussed the arrangement of the stalls of the cowhouse, with their accompanying feeding and dunging passages, we must take up the consideration of the various details connected with the construction. And first, as to the breadth of the building, this, of course, regulating the width of the working spaces of the floor of the house. As a rule, this is almost invariably too small, a width from "in to in" of front and back walls of 16ft. only being generally given. The very least width should be 18ft.; but if it exceeds this, as greater consequent width may be given to the dunging floor spaces, the extra width and extra cost will never be grudged, in view of the greater convenience which it gives in working. Those only who have had the contrast forced upon them in keeping cows in a house too narrow, and in another with ample width, can be sensible of the value of the advice given when we say do not grudge a little extra space in the working floor.

The width in Fig. 1 is over 18ft, but this includes the width of gutters and posts.

The width of the stall space is the next point which comes under consideration; and in connection with this is the question, which is the better, "a double stall to hold two cows, or a single stall for one?" We have no hesitation in strongly recommending the single stall in preference to the double; and in this we follow the highest agricultural authority, who points out that if we consider the nature of the animal, its likes and dislikes, its prejudices and partialities, "a double stall is objectionable for several reasons." As a rule, all stalls are made too narrow; some so much so that the animals are only too literally "confined" in them. The more we secure the comfort of our milking cows the better the return in money value we shall obtain from them—this is too often forgotten. There is a practical danger in making the width of the stalls too great, however, as in this case the cow has room to turn so completely round, or nearly so, that she will dung at the top of the stall. This will happen if the width is five feet or over it, as some recommend. A width of six inches less than this will be found the best; although, where space is unfortunately restricted, the width may be reduced to four feet, but this should be the minimum.

The floor of the stall is made of a very wide variety of materials—as stone, brick, asphalte, timber, and concrete. If of stone, or brick on edge, these materials should not be laid at the top part of the stall, as they are too hard for the cow to raise herself up on—this rising up being always done by the cow getting first on her fore knees. The upper part should be of softer material, as boarding or asphalte. By far the best

floor is that made of Portland cement concrete, asphalte ranking next. The concrete can be laid with a surface unbroken by a single crack or rent, perfectly waterproof, easily cleaned ; and gutters or channels can be formed in its surface, of any form, in any direction, and of any depth, with the greatest of ease, and even by unskilled workmen. In Fig. 4 we give a plan of stalls with the floor laid out with concrete and with channelled surfaces, as *a a*, *b b*, all of which conduct the urine, or the water with which the floor may be cleansed from time to time, to the main gutter, *c c*.

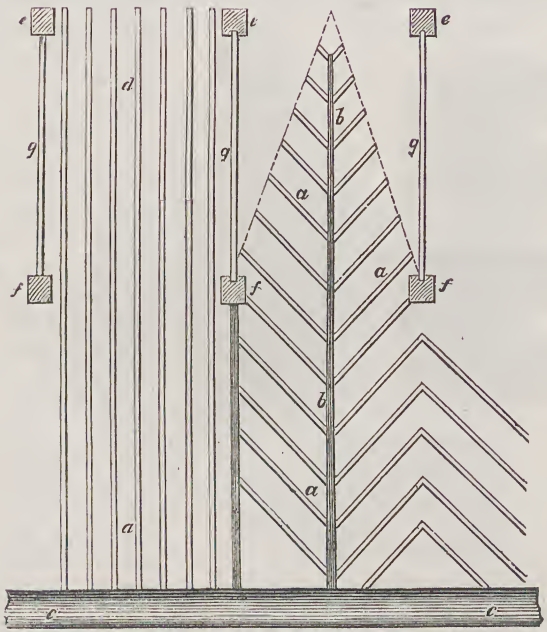


FIG. 4.

The side channels, as *a a*, have a slight inclination towards the centre of the stall at which the longitudinal channel *b b* is placed, this leading direct to the main drain, *c c*, which runs along in front of all the stalls, and the ultimate place of deposit of which is the liquid manure tank. In place of the channels being as at *a a* and *b* in Fig. 4, they may be made as at *d d;* or the floor of the stall may be unbroken in its surface, but inclined from the upper or manger end towards the main drain, *c c*, Fig. 4.

In the same figure, *e e* are the head posts, *f f* the heel posts, and *g g* the travis boards. Some feeders prefer to have the animals lying upon sparred or open timber-work frames, which are so high above the floor, that a space is left beneath, into which the dung falls ; these frames being movable. From what we have seen of the use of these sparred frames we would not recommend them ; they are troublesome to remove, and anything that is troublesome is almost certain to be overlooked, and the result is that the space below the frames is allowed to retain the ordure too long. The upper part of the stalls might be made of sparred boarding ; but, on the whole, we have found no floor equal to the asphalte or concrete, these materials giving unbroken surfaces, which are kept easily clean.

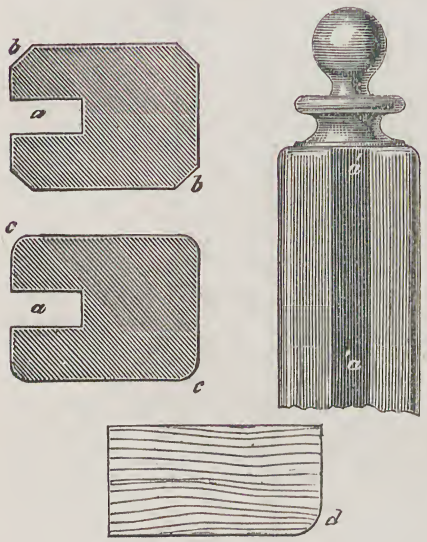


Fig. 5.

The material of the travis board or division beween the stalls is next to be considered. Iron fittings are now becoming very common, and they are generally well and neatly made. It is questionable, however, whether these are so comfortable to the animals as wooden fittings, which afford much warmer surfaces for the animals to lie in contact with than iron does. The heel and head posts might be made of iron, and the travis boards of wood, as it is these with which the animals chiefly come in contact when lying down. In the majority of country districts timber fittings are much more easily procured and made than iron ones, and a few hints as to their construction will here be in place. The posts should be made either with angular edges or corners, as at *b b* in Fig. 5, or rounded off as at *c c*. This is not so essential in the case of the head post as in that of the heel post, as it is with the latter the animals come chiefly in contact. And it is surprising how much suffering may be entailed upon the animals by neglect of the simple precaution here recommended; for as they come rubbing up against the sharp corners, they

get the skin excoriated and sometimes severe wounds are inflicted. This is more especially the case if the door cheeks or posts be left with the "arrises" or sharp corners left on; for the animals in going into the cowhouse are frequently playful, and drive one another up against the door, and sometimes by careless attendants they are driven in roughly. In all cases the corners of openings, of gate posts, &c., should be taken off, either as at *b b* or *c c*, Fig. 5; in the same figure *d* shows the plan of the corner brick of a door with the external angle, *d*, cut off. A method of finishing off the upper parts of the head and heel posts is shown in Fig. 5 at *a' a'*. The travis boards or division boards between the stalls are fitted into grooves in the posts; these are shown at *a a*. Generally, the travis boards are

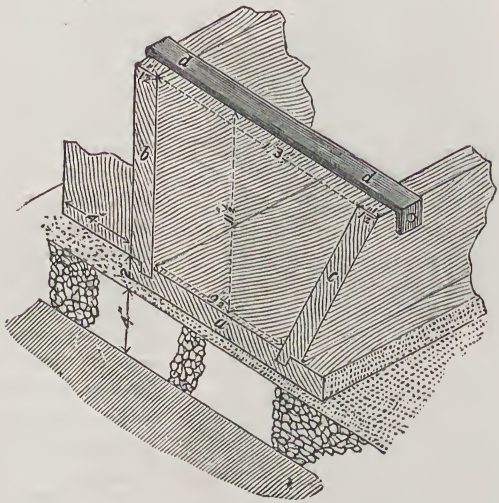


Fig. 6.

tongued and grooved and fixed permanently at their ends into the grooves of the post. We are inclined to recommend that they should be left loose, simply being passed into the grooves one after the other. This arrangement will facilitate their removal for cleaning, an important point when disease is rife amongst stock—important, indeed, at any time.

The part of the floor of the cowhouse on the other, or wall side of the gutter, that is, furthest from the manger, should have a slight inclination from the front wall towards the gutter, and have its surface channelled, if made of concrete. This will facilitate its being cleaned. The floor at its junction with the wall should—if made of concrete—be finished off

with a concave surface joining the wall; this will do away with a sharp corner, and present a surface which will be easily cleaned. This may appear a small matter, but it is in attention to such minutiæ that the care of the designer of farm buildings is shown, and that the health of the animals which they shelter is secured.

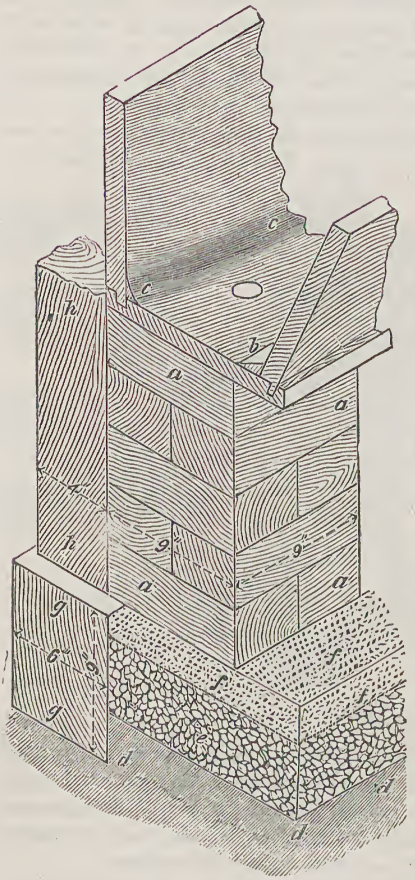


Fig. 7.

We now come to the next fitting of the stall, namely, the mangers or feeding troughs. These are of two kinds, low and high placed mangers, these being respectively illustrated in Figs. 6 and 7. Both of these are made of timber, and home made, as, indeed, we suppose all the fittings to be; by the term home made, we mean the labour obtainable in the district, the village carpenter, and the like. In Fig. 6 the bottom of the manger rests upon the concrete floor, part of which is shown fitted up in sections, *b* the back, *c* the front, the two being held together by the iron clamp, *d d*. In Fig. 7 a brick foundation, *a a*, is shown, on which rests the bottom, *b c*, of the manger —the dimensions of this being the same as in Fig. 6. To facilitate the cleaning out of the manger, the corners should be done away with, and filled in either with an angular piece, as at *b*, or, better still, a rounded-off concave piece, as at *c c*. In this figure we show the method of forming the concrete floor, *d d* the soil; above this is placed a layer of broken stones, 4in. in depth, and above this the cement concrete floor,

f f, to a depth of 2in.; *g g* is the base in which the head post, *h h*, is fixed.

As regards the relative merits of the two kinds of mangers here illustrated, a good deal has been said; but looking at physiological circumstances connected with the animal, its mode of feeding, and the kind of food of which it will most largely partake of when housed in the winter season, we join in the recommendation of a high authority to use the high manger, as in Fig. 7.

Alongside of the manger should be placed the water trough. This may be made of timber, and of length sufficient to fill up the remainder of stall width, and lined with lead. A pipe should communicate with the overhead water pipe system, by which it may be filled with water when desired; and another pipe should convey the waste water to the drain, this waste pipe communicating with the bottom of the trough, and provided with a water-tight plug. Cast iron mangers and water troughs are now made very neatly in one; they are cheap, and easily fitted up. Very good mangers and troughs are also now made of earthenware, and are largely used. They are cheaper than those of iron, but of course liable to be more easily broken. Some dairymen prefer to have no fixed manger, but use what they call in Lancashire a "licking tub." This is simply a feeding trough, with sloping sides and ends, about twenty-four to thirty inches long, and the other dimensions about those in Fig. 6. This is brought to the cow at feeding time with the mash or food, and taken away when the cow has finished her meal. The plan has this advantage, that, not being a fixture, the trough or tub has the chance of being pretty often cleaned—oftener than the ordinary fixed manger has. Water is supplied to the cow in an ordinary pail. The only fixture in the stall is therefore the hay rack, and this even is often dispensed with, the hay being either thrown down at the head of the stall or supplied out in the form of mash. There are those who advocate that the stall should have a fixed water trough, always filled with water, so that the animal may go to drink as often as it feels disposed. This would appear to be the natural way, but others do not agree with it. The iron manger and water trough, already alluded to as being now made in one piece, has often a third member attached—namely, a hay box or rack. In some forms of feeding apparatus this is placed so that the animal feeds at the same level as the manager; in others the hay rack is placed above the manger, at or about the level of the head of the cow; in others, considerably above this height. The general opinion as to the height at which the hay rack should be fixed is in favour of a low placed rack. Fig. 8 illustrates a rack made of timber, which may be fixed at the level of the animal, that is, the centre of the rack in that part from which the animal

will pull the hay being at this level. If the rack is placed as low as the manger, that is, below the level of the head of the cow, a cross-bar,

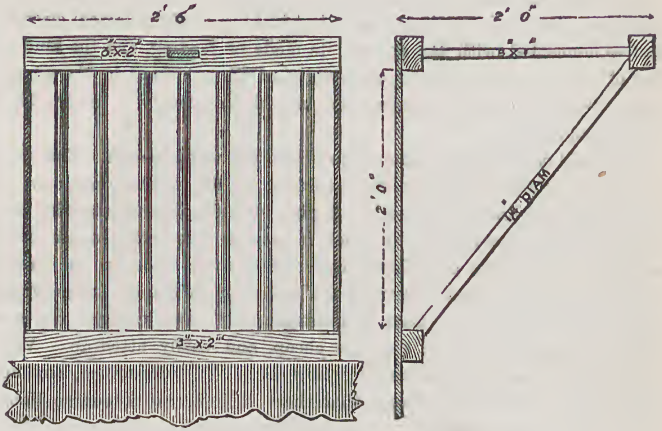


Fig. 8.

as *d*, should be fixed in the centre of the rack, to prevent the cow from pulling the hay or grass out of the rack at the top.

We now come to the method of tying up or fastening the cow to the

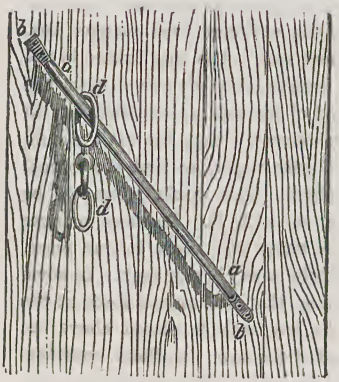


Fig. 9.

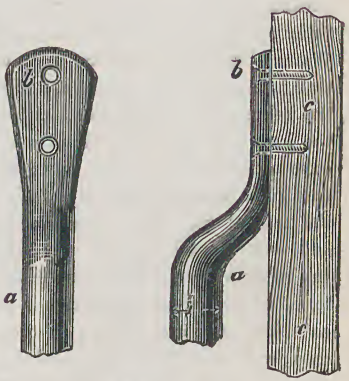


Fig. 10.

stall. There are several methods in use; but we shall only illustrate two, which appear to us to be the best. In the first, illustrated in Fig. 9, a

wrought iron rod, *a a*, is bent at the ends as at *a* in Fig. 10, and flattened out as at *b* ditto. These flattened-out parts are provided with holes by which the rod is secured to the travis boards, *b b*, Fig. 9. Previous to fixing the rod, the first link of a chain, *d d*, is passed over the rod *a a*, and the free end is fastened round the neck of the cow, or it is attached to a ring in the leather band which goes round its neck. The rod, *a a*, is placed at an angle, so as to admit of the easy sliding up and down of the ring of the chain. In Fig. 11 the second method is illustrated. An aperture, *a a*, is cut in the travis boarding nearly as long as the boarding is high, and in the centre of this a wrought iron rod, *b*, with ends made as at *a b* in Fig. 10, *c* Fig. 11, is fixed to the boarding, the chain passing up and down this as in Fig. 9. Of these two methods we prefer the first.

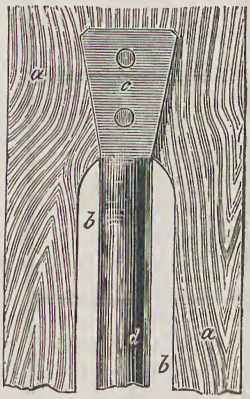


FIG. 11.

Fattening Cattle Houses.

WE now proceed to take up the department of houses for fattening beasts.

Where what is called the "soiling" or "stall-feeding system" of fattening cattle is adopted—that is, in which the animals are wholly housed, being only allowed to get an "airing" for a limited period in the yard each day—the arrangements of the house in which they are kept are precisely the same as in those for dairy cows, already described; and even where the cattle are housed for but a small portion of each day, some prefer the stall system to the other systems of fattening cattle now to be described. The various systems of accommodating cattle which are thus being fattened for market may be divided into two classes—first, those in which the animals are confined to a certain limited space; and second, those in which they are allowed space to move about in as they desire. Under the first class we place two kinds of accommodation, first the "stall" system, already described; second, the "box" system. Under the second class we place also two kinds of accommodation, first the large open court and shed system "for a number of animals," other-

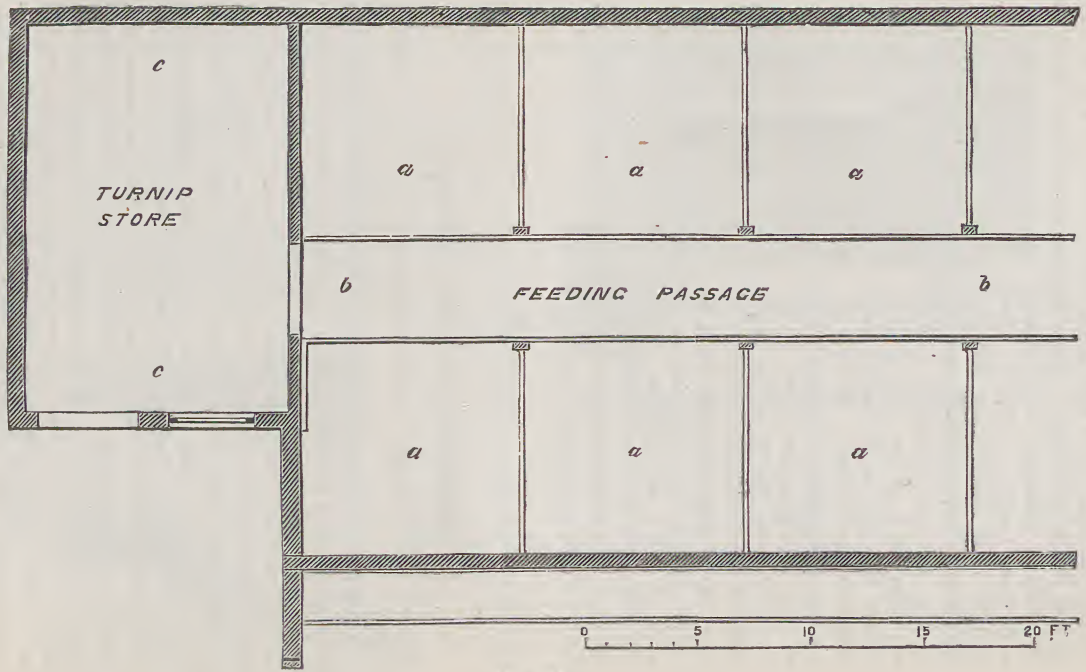


Fig. 12.

wise known as the "curtain" system; and second, the small open court and shed system "for one or two animals," termed the "Hammell."

In the stall feeding system, the animals are tied up, or confined to the stall, all the time they are in the house. This restraint does seem unnatural, and a well known agriculturist describes it as the "unnatural practice of tying up cattle to stakes, denying them the use of their limbs, the choice of their position in lying down, and the means of varying the atmosphere in which they are confined—a matter in which cattle are peculiarly discriminating and sensitive." On the other hand, a very large amount of experience, both in this country and America, and markedly on the Continent, in the soiling of cattle, in which they are almost altogether kept in the house, goes far to prove that this system is not so prejudicial to the health and to the fattening propensities of the animal as at first sight it appears to be. We have quoted one distinguished farmer against the stall system, we shall quote another in favour of it: "A considerable comparative experience has convinced me that no other method will give equal accommodation for the same outlay; whilst I am persuaded that, in regard to economy of food and litter, facility of labour in attendance, health and progress of the cattle, and systematic arrangement altogether, stall feeding is superior to any other that has yet come under my notice." So much for the stall system, in which the animals are tied up or confined.

We now come to consider the "box" system, in which the animal is allowed a certain limited amount of space, in which he is free to move about at will. The "box" system bears the same relation to the "stall" system as the "loose box" does to the stalls for horses. The "box" is, in fact, a loose box for cattle, with this peculiarity, that the dung or manure which the cattle produce is not removed, but is allowed to accumulate till a certain period, when it is then removed; the cattle always remaining in the box, and moving about in the space, keep pressing the manure down till it acquires a very firm and compact texture, thus preventing the smells which might otherwise arise. The space allowed for each box is 100 square or superficial feet, a very usual proportion of dimensions to give being 10 feet square. Some, again, give a greater length than breadth to the box, making it 12ft. long by 8ft. broad, which gives 96 superficial feet, or nearly the same as the other. There are various ways of arranging and constructing cattle boxes, according to the fancy or judgment of the builder and designer. The boxes may be arranged double-stall fashion, with a central feeding passage between, and all under a roof. This we illustrate in Fig. 12; where *a a a a* are the boxes, *b b* the feeding passage; or they may be arranged, as in Fig. 13, on each side of the straw barn—as *a a*, *b b*, the boxes; *c*,

the straw barn; *d e*, the feeding passages. The turnip store should always be placed in near contiguity to the boxes, as at *f* in Fig. 13, or *c c* in Fig. 12. The manger, as *g h*, Fig. 13, is of course loose, so that it can be raised as the dung rises in the interior of the box. A water trough, as in Fig. 13, should also be provided to each box. In Fig.

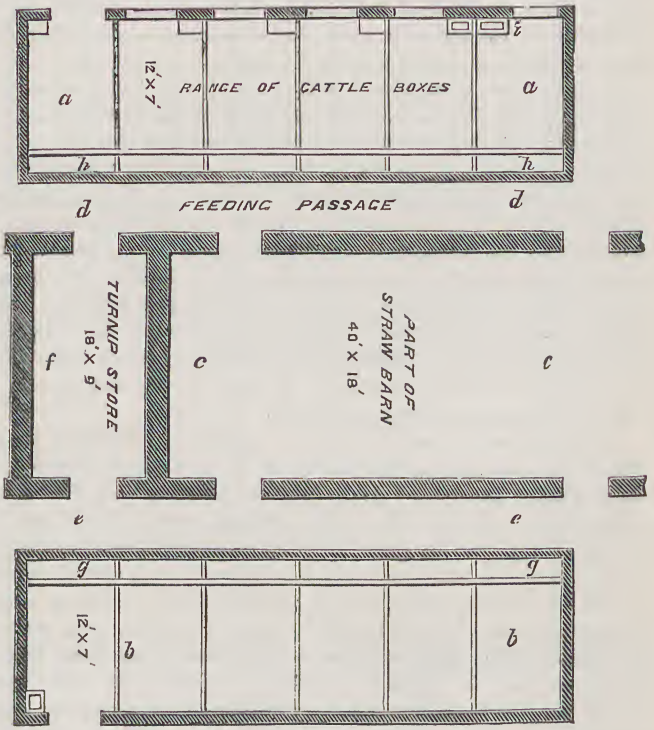


Fig. 13.

14 we give a cross, or transverse section of the feeding boxes in plan in Fig. 12; illustrating the method of constructing the same; in which the necessary depth of receptacle to hold the manure is obtained by excavating the spaces *a a* below the ground level, *b b*; carrying the outside walls, *c c*, down to the level of the floor of box. The divisions between each box are made by cross walls, and these are surmounted either by hurdles or gates, *d d*, or by close boarded travises, *e e*. The two ranges are

covered by a roof of a single span, on the queen post principle, giving a space, *f f*, in which hay may be stored; *g g*, the pillars at end of divisions *d*, *e*. Ample ventilation is secured by means which will be described when we take up the subject of ventilation, as applied to farm buildings, in a separate and distinct chapter. Various opinions are held as to the value of the "box" system. An eminent authority in favour of it states, "That there cannot exist in the mind of any individual who may have witnessed the feeding of cattle in boxes properly carried out a doubt of its being a most effectual mode of providing due shelter, perfect freedom from molestation, and complete comfort to the animals — all conditions most essential to rapid thriving; nor can

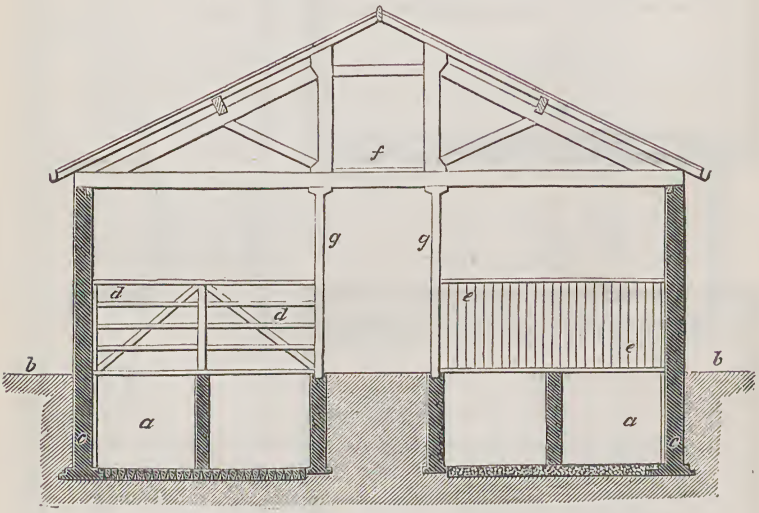


FIG. 14.

any one behold the accommodation without being thoroughly convinced of the great economy in collecting the egesta, and preserving it in the very best state for its purposes, and yet without the least exhalation of effluvia. Whatever may be supposed, those who have not seen the box-feeding system in operation are hereby assured by the writer, who has carefully watched its effect, that it is in every respect consistent with perfect cleanliness and perfect health of the beasts." Another authority states that, "as a manufactory for manure," he believes there is no system equal to it; and that it has this advantage over the stalls,

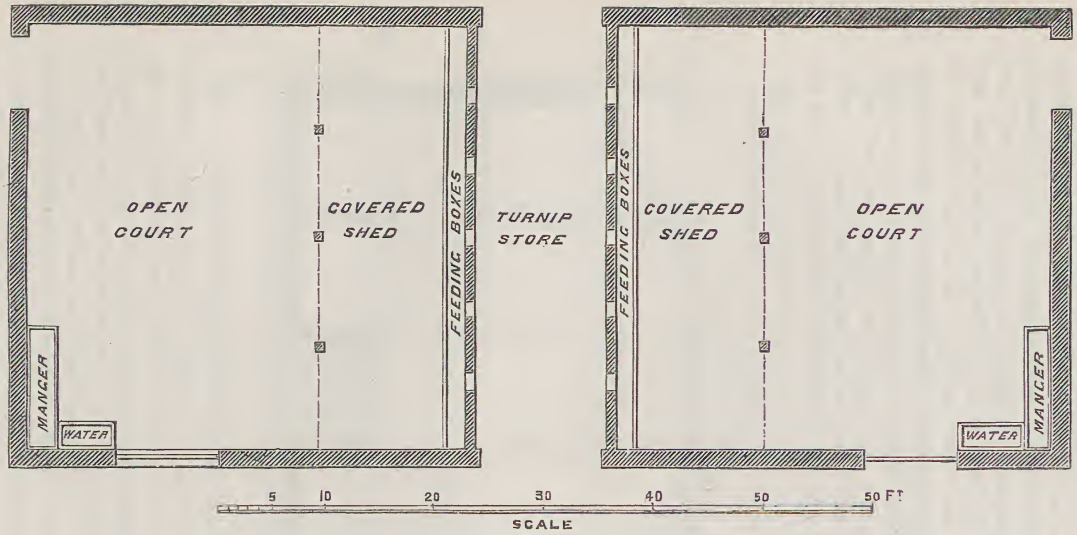

OPEN COURT
COVERED SHED
FEEDING BOXES
TURNIP STORE
COVERED SHED
FEEDING BOXES
OPEN COURT
MANGER
WATER
WATER
MANGER
5 10 20 30 40 50 50 Ft
SCALE

Fig. 15.

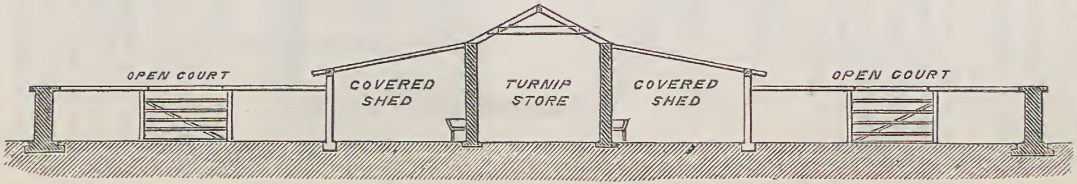

OPEN COURT
COVERED SHED
TURNIP STORE
COVERED SHED
OPEN COURT

Fig. 16.

that it gives the animals greater freedom of action while it economises the food.

We now come to the "large open court and shed system," being the first of the second systems of fattening cattle in which they are allowed freedom of action. In Fig. 15 we give a plan showing one arrangement for this system, Fig. 16 being a longitudional section of the same. In the "shelter shed" it is usual to allow 60 superficial feet for each animal, and in the "open court" 20ft. and 40ft. Where the court and shed system is adopted for six animals, the shed is recommended by able authority to be 36ft. long by 10ft. wide, and the yard 36ft. square. The floor of both the shed and court should be either paved or concreted, and formed so as to shelve or slope towards a point, at which should be placed a grating leading to the drain communicating with the liquid manure tank.

We now describe the small court and shed system, known in the north as the Hammel system; this is illustrated in Fig. 17. The shelter shed is covered over. This is, in fact, a modification—so far as construction goes — of the system adopted nearly a hundred years ago in Gloucestershire, and described by Marshall, who reported on the farming of that county. In the Gloucestershire system one animal only was allotted to each stall and little yard; in the hammel system, as a rule, two animals are given to each. In both, the large and the small court and shed systems, the same feature or principle is observed, namely, the giving of the animals a certain amount of freedom approaching that of the field, and at the same time affording them shelter from inclement weather, to which they can go at all times. Marshall, in his account of the Gloucestershire system above alluded to, says, "each bullock has a house and a yard to himself in which he goes loose, occupying them by turns as appetite or amusement directs him, having a manger and a drinking trough to go to at pleasure. He of course eats when he is hungry and drinks when he is thirsty. He is also at liberty to rub or to lick himself, as well as keep his body in a degree of temperature as to heat or cold. Theory could not readily suggest more natural principles." The first agricultural authority, who had large experience as to the small court and shed or

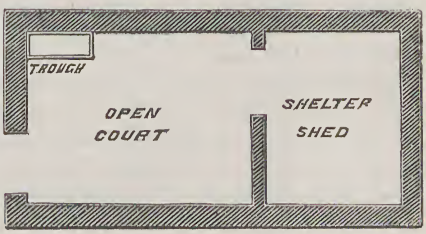


Fig. 17.

hammel system, gives this striking testimony in its favour: "From the result of my own experiments, as well as the unanimous opinion of every agriculturist with whom I have conversed on the subject, I feel convinced that there is no point more clearly established than that cattle improve quicker, or in other words, thrive better, in open hammels than in close byres." And another very eminent and well-known writer, on agriculture says: "I am sure that exposure at will to the sun and air, and even rain in winter, is much more conducive to the health of an ox than constant confinement under a roof." And it is worthy of notice here that a well-known practical farmer, after having for six or seven years kept his beasts in houses, turning them out only once a day for exercise, was compelled through the evil effects of the system upon the health of the animals to abandon the system, and to adopt the open court and shed system in its place. There is an objection made to the open court and shed system, that the manure made in the open court is not so good as that made in boxes, as it is allowed to be exposed to the atmospheric influences. This objection is, however met or rather it does not obtain, where care is taken to litter the court evenly—to have the bottom of it well paved or concreted, and to have the feeding rack or manger and turnip trough so arranged that they can be moved to and kept at different places in the court, so that the animals will tread down the litter and their own manure as evenly and uniformly as possible. All the courts, whether on the small or large systems, should be provided with water and turnip troughs. The turnip store should be so arranged in the plan that it will be in convenient proximity to the feeding sheds. Scarcely a better arrangement could be made than that shown in Fig. 15, where the turnip store is placed centrally between the two courts and sheds, the turnips being supplied to the mangers in the sheds right and left, as shown. In the case of boxes or stalls, a turnip store is equally necessary: the arrangement shown in Figs. 12 and 13 will be found convenient in practice. In the small court and shed system, it should be remembered that the chief feature it presents in practice is the convenience it affords to the feeder to put up one or two animals, according to age, condition, size, &c.

The principle is quite departed from when they are made so large as to accommodate as many as six or eight animals; for two or three large or six small beasts the dimensions should not exceed these: court, 14ft. or 15ft. broad by 18ft. or 19ft. long; shed, 14ft. or 15ft. by 12ft. or 13ft. For one animal the court may be 10ft. by 9ft., with a yard containing twice this superficial area. As regards the expense of the different systems now described it is very difficult to give any definite statement, much depending upon the method in which they are arranged, and upon the

details of construction adopted. As a general rule, however, it may be stated that the stall feeding system, and the small court and shed systems, are the two cheapest; and that many practical men think that of these two, the stall system is the cheaper. Some are inclined, however, to give the preference in this regard to the small court and shed system.

Stables.

THE next important building of the farmery is the stable, to the details of arrangement and construction of which we now beg to direct the attention of our readers. Many of the details of the erection of these buildings are very similar to those connected with cowhouses.

The arrangement of the stalls may take, according to circumstances, the form of one or other of those methods we illustrated in connection with these buildings; but in Figs. 18 and 20 we give what may be considered the normal types. In Fig. 18 the stalls, as seen, are placed close up to the back wall, the mangers, hay rack, and water trough intervening. In Fig. 20 there is a feeding passage running along the back of the line of mangers, &c., coming between them and the back wall, as shown. Each of these plans has its advocates; but the balance of modern opinion seems to be in favour of the plan in Fig. 20, with the feeding passage at the back, and for reasons which will be seen further on.

The dimensions of the stalls have given rise to keen discussion. It is evident that, so far as room or space for cleaning the stable is concerned, much, if not all, of what we have said on this point while describing the details of cattle houses will be applicable here. A width of stable from wall to wall much advocated, and still, unfortunately, much more widely followed out in practice, is 16ft., as in Fig. 19. Now, if the spaces taken up by the fittings and the animal be calculated, it will be found that the space left for dunging and cleaning will be at least two feet too narrow, so that the least width which should be given is eighteen feet; but a width even greater than this is necessary if a feeding passage be kept at the back, as in Fig. 20 (plan) and Fig. 21 (section). Taking the width of the feeding passage (*a*, Fig. 21) as 3ft. the width of rack and manger (*b*) over all, 2ft.; length of stall or part occupied by the horse, measured from the outside line of manger to the outside of heel post (*c*) next the gutter, 9ft.; the width of gutter, 1ft.—this width being the least in which a spade or dung shovel can easily work; and the width of dunging passage (*e*) at 4ft., then we have a

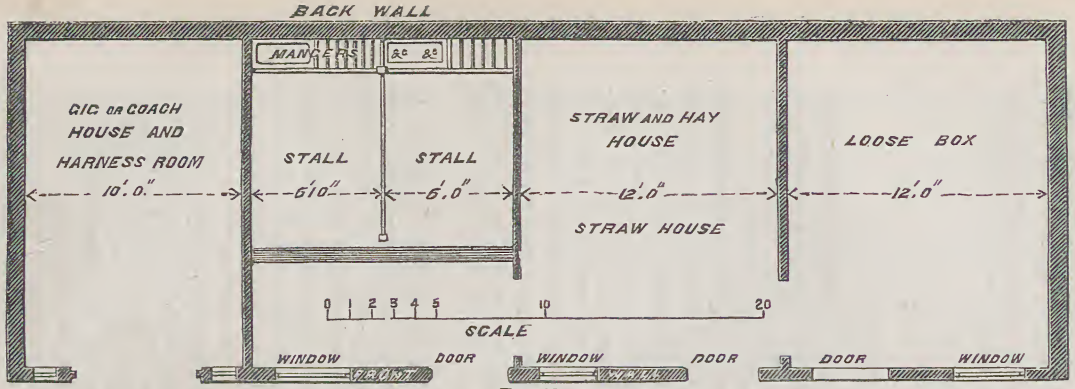

BACK WALL
MANGERS
&c &c
GIG OR COACH HOUSE AND HARNESS ROOM
10'.0"
STALL
6'10"
STALL
6'.0"
STRAW AND HAY HOUSE
12'.0"
STRAW HOUSE
LOOSE BOX
12'.0"
0 1 2 3 4 5 10 20
SCALE
WINDOW
DOOR
WINDOW
DOOR
DOOR
WINDOW
FRONT
WALL

FIG. 18.

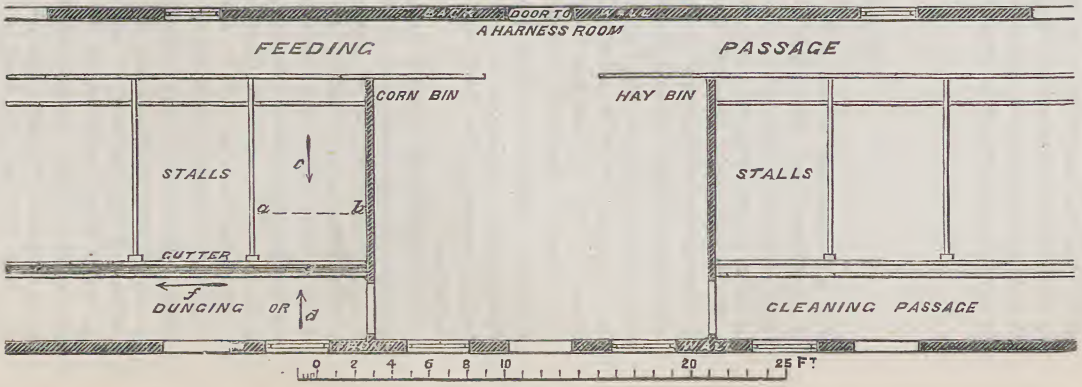

BACK DOOR TO HARNESS ROOM
WALL
FEEDING
PASSAGE
CORN BIN
HAY BIN
STALLS
STALLS
c
a
b
GUTTER
DUNGING
OR
d
CLEANING PASSAGE
FRONT
WALL
0 2 4 6 8 10 20 25 FT

FIG. 20.

width from wall to wall of 19ft.; but by reducing the length of distance (*b* to *c*) from nine to eight we get the width 18ft. We should, however, recommend, in cases where the trifling additional expense be not objected to, to have the full dimensions as above stated. These are the dimensions across the building. The only one in the length of it open for

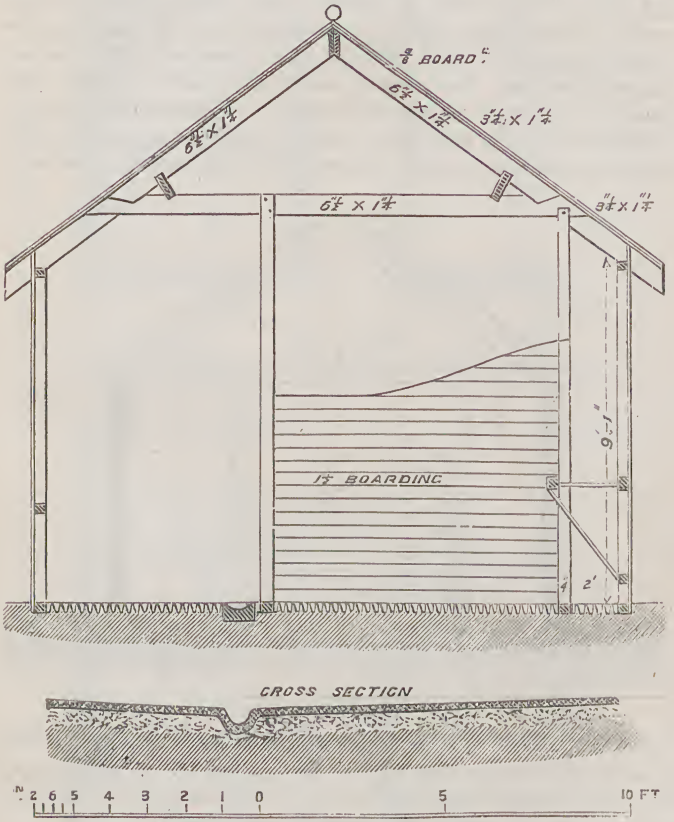


FIG. 19.

discussion is the width of the stall from *a* to *b* (Fig. 20). This also has given rise to much discussion, but it has settled down to a sort of tacit agreement that 6ft. should be the orthodox width from centre to centre of travis, or division boards; but we would recommend the full width to be given within the boards—that is, from inside to inside.

Some eminent authorities on horse breeding go in for the "loose box," which may be described as a separate apartment, the width of which is usually twice that of an ordinary stall, namely, 12ft. This loose box (see Fig. 18) is fitted up with rack, manger, and water trough, and the animal is not tied up, but is left "loose," so that he has the full liberty of his room. If natural actions are to be taken as any reason why we should adapt the arrangement of the feeding places of the farm stock to meet them, then the "loose box system" is undoubtedly the best. But granting that it be, it, taking up much more space, is unfortunately much more expensive in construction than the ordinary stall. The other plan, moreover, possesses advantages which even the loose box does not. As part of a regular stable, however, a

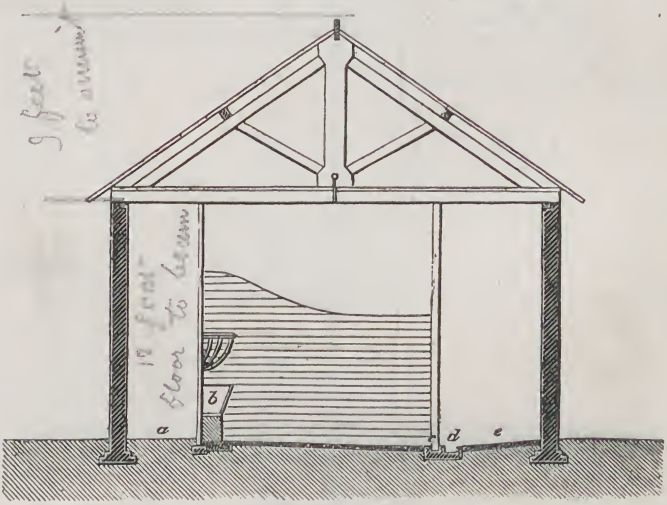


Fig 21.

"loose box' should be given, if not two; if in no other way, they will be useful at times as "infirmaries" for sick horses. And a separate sick room has more than once saved a lot of animals, by the facility it afforded of at once isolating them from their neighbours.

In a larger farmery this infirmary can be situated at a greater distance from the other stalls; in the case of isolated stables, as those for a private residence, the arrangement shown in Fig. 22 is easily adopted. The plan here shown comprehends the whole of the apartments necessary for the "stable of a private residence" where a pair of horses are kept with a nag, for which the loose box is used. The arrangement here indi-

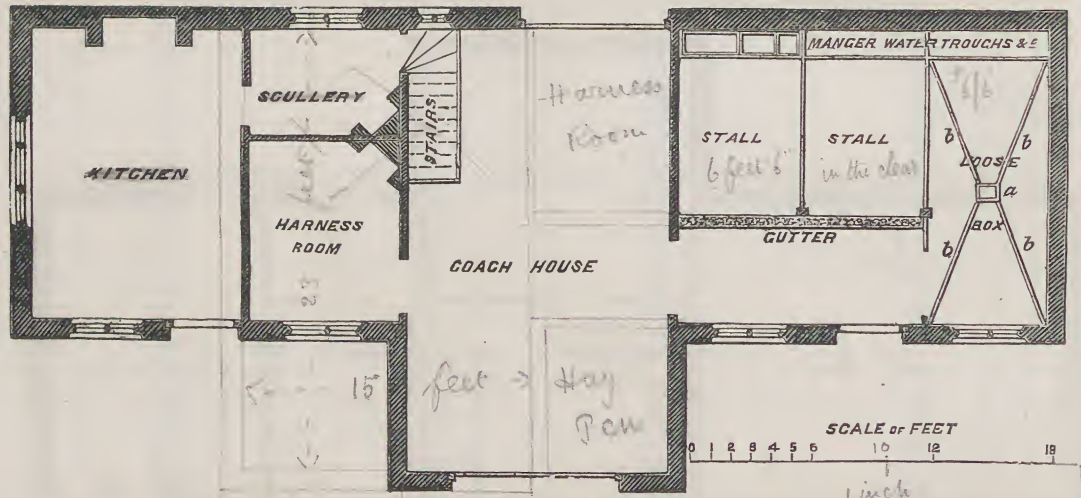

KITCHEN
SCULLERY
STAIRS
HARNESS ROOM
COACH HOUSE
Harness Room
MANGER WATER TROUGHS &c
STALL
STALL
LOOSE
BOX
GUTTER
a
b
SCALE OF FEET
0 1 2 3 4 5 6 10 12 18
1 inch
2 inch

FIG. 122.

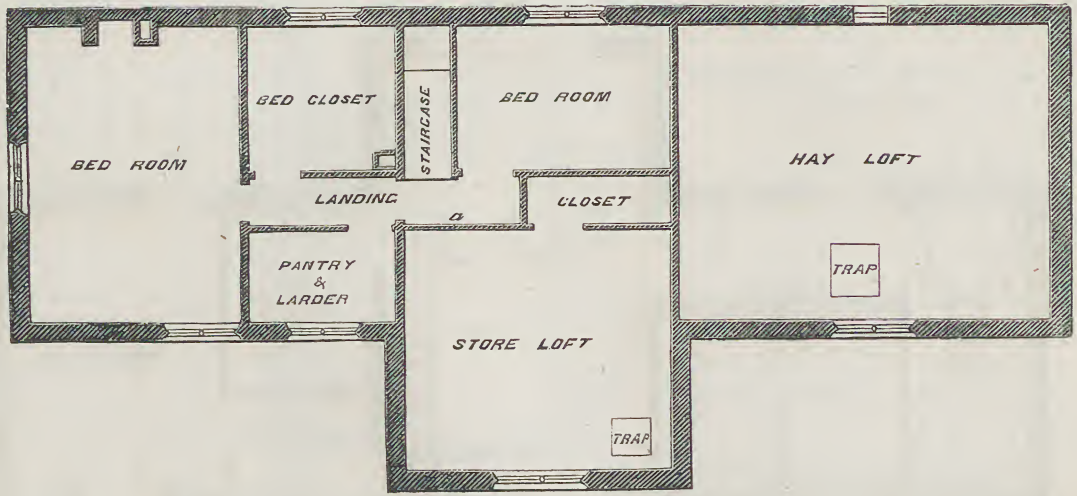

BED ROOM
BED CLOSET
STAIRCASE
BED ROOM
HAY LOFT
LANDING
CLOSET
PANTRY
&
LARDER
TRAP
STORE LOFT
TRAP

FIG. 23.

cated gives on the left hand side the apartments connected with the house of the coachman, comprising on the ground floor a kitchen and scullery, and on the second floor (Fig. 23) a bed room, a bed closet, a pantry or larder, and a small bed room, which may be used for the stable boy. To the right hand are the apartments making up the stable

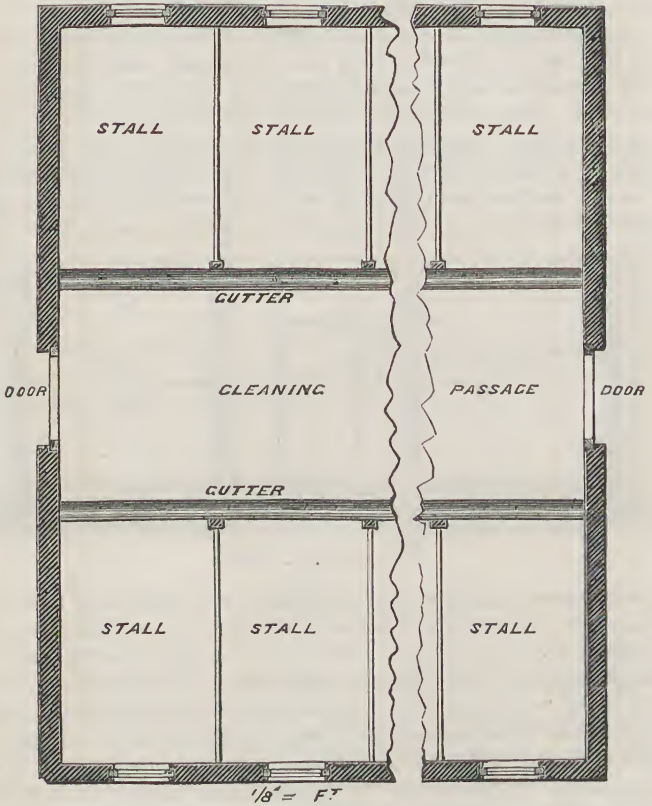


Fig. 24.

proper, to which the only exception is the "harness room," taken from the left-hand part of the plan. The stable (Fig. 23) comprises two stalls, a loose box, and the coachhouse in the centre, between the stable and the house departments. On the second floor, Fig. 23, there is a hay loft, a store room, entered by a trap from the coach-house; although perhaps

a better arrangement would be, for security, to do away with the trap and substitute a door, placed, say, at *a* in Fig. 23, in the second floor landing; the store room has a "lock-up" closet. Above the stalls and loose box is the hay loft (see Fig. 23.) This arrangement of the two classes of apartments necessary for a stable of the kind now under consideration may be altered *ad infinitum;* but the plans we have given show in a general way what is required, and how this may be met.

Another arrangement is shown in Fig. 24, which, our readers will observe, is a modification of the plan of arranging cattle houses, with the dunging and feeding passage in the centre, and the stalls ranged right and left. This plan is obviously better adapted for a large, or comparatively large, number of horses, than for cases where only a few are kept; the difficulty, however, would only be in the planning, getting the *vis-à-vis* stalls so placed that they would not interfere with the arrangement of the other parts. For a pair of horses, for example, the width

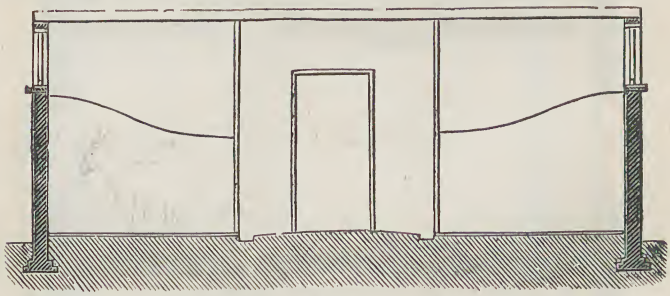


Fig. 25.

of the central dunging passage would give a plan which would not look very well. Fig. 25 is part section of Fig. 24, up to roof line, showing dunging door at end. In Fig. 26 we show a plan in which there is accommodation for four horses in single stalls and a loose box, the coach house and harness and store rooms being in the centre, while the living apartments for the coachman are all towards the right hand. Any one of the other plans of arrangement is open for adoption, however small be the number of animals kept. In Fig. 26, *a a a a* are the four stalls; *b*, the loose box; *c*, the hay house; *d*, the coach house, with harness room (*e*) off it; the coachman's living house enters by the end door at *f*; *g*, a small pantry; *h*, kitchen; *i*, coal place; *j*, scullery; *k*, bed room.

Much in the arrangement of double-ranged stalls with central passage, as shown in Fig. 24, is praised, and praised justly. However, it would be greatly improved by a feeding passage being placed at the head of

each range of stalls; and this not merely on the score of convenience in feeding the animals, but for the maintenance of their health. For the existence of an open space between the heads of the horses and the dead wall of the stable is manifestly an advantage on the side of health. This arrangement, although good, would, however, increase very materially the width of the stable; and by correspondingly increasing the span of the roof would add to the expense of its construction, and this part of a building is the most expensive. The plan of arrangement, therefore, shown in Fig. 20 will be the best, we think, for the majority of cases in actual practice; the arrangement even of Fig. 18 may be carried out, although we do not approve of it as we do of that in Fig. 20, if the

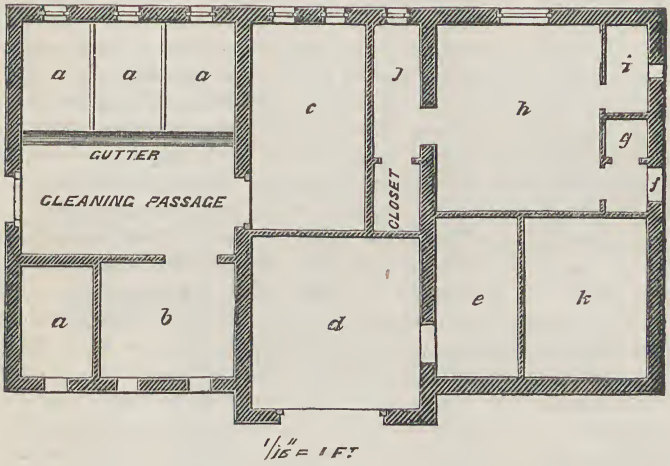


Fig 26.

methods of ventilating, &c., yet to be described are adopted, so as to secure the health of the animals.

Having now gone into and briefly discussed the question of arrangement, we proceed to describe those details of construction tending to render the building healthy, and its work also economical in practice, in the saving of time, &c.

And first as to the floors of the stable. Much of what we have said on this subject in connection with cattle houses obviously applies to stables. One point as regards that part of the floor on which the horse stands or lies has often been discussed, namely, whether it should be made level, or with a slope or incline from the manger towards the gutter,

but a slight fall or incline, say, about half an inch of a fall for each foot of level surface, will at least be convenient in this respect, that it will enable the stall floor to be kept cleaner with greater ease than if it were deal level, and this without any detriment to the animal's health. So far as mere standing is concerned, it is beyond a doubt that the horse will prefer a level place to stand upon; but to this also there are exceptions, for we have not seldom seen a horse stand by preference on an incline when a level part was within a few inches of him. We believe the best material for the surface to be concrete, and this may be channelled, so far as the stall floor is concerned, with small indented (circular in bottom) channels running in the direction of the arrow, *c*, Fig. 20, and, so far as the floor of the dunging passage is concerned, running in the direction of the arrow, *d*; both systems of channels leading to the main gutter, *e e*, which, again, has its fall in the direction of the arrow *f*; this drain, leading to the liquid manure tank, which should be placed as far as possible from the stable. The gutter, *e e*, which runs along the heels of the horses, may be covered with a cast-iron grating, perforated throughout its whole length with small perforations to allow the urine, water used in cleaning the stable, &c., to pass easily to the interior. To admit of the interior of the gutter, *e e*, being cleaned, the cast-iron cover should be made in short sections, so that any one or all of them can be taken off; and when so taken off a spade can be run easily along the bottom of the gutter, and bring up with it at intervals the deposited solid matter. All these drains are open drains, which, for ordinary stables, are better in practice, we think, than the covered underground drain, which, no doubt, theoretically, is the best; but in the loose box, as in Fig. 22, this open drain system is not so convenient. The underground drain is therefore for this recommended, and the opening to this, which will also finally lead to the liquid manure tank, is placed at *a*, Fig. 22; the floor sloping or being "dished" in towards this from all sides as shown by the lines *b b b b*, these lines being channelled lines, the opening to *a* is covered by a cast-iron perforated grating. This system of central opening to underground drains is sometimes adopted for ordinary stalls. The "fall" of the drain or gutter (*e e*, Fig. 20) may be somewhere about one in fifty or sixty. This fall will naturally give a greater depth to the gutter at the far end than to that at which it starts. This greater depth, by being arranged to be at or near where the open drain joins the liquid manure tank, will form a good catch or trap by which the solid deposit may be gathered up and collected. This is shown in the sketch in Fig. 27, where *a a* is the bottom of the drain or gutter, *b b* the level of the ground, giving a fall or shoulder at *c*, from which the liquid matter will

flow over by the outlet *e* into the tank, part of which is shown at *d*; this arrangement may in some cases enable the ordinary "drain trap" to be dispensed with; but it will be better to err on the side of safety, and have a trap placed at the point where the drain or gutter leaves the stable. This trap should be looked to frequently, so as to prevent the accumulation of dirt within it, which would soon destroy its efficiency as a "trap" for catching the foul air and preventing its issue into the stable. Moreover, the open drain, as in Fig. 27, may not be allowed outside the building, so that a trap in this case would be essential; the drain being altogether closed after its issue from the building, which would be more in accordance with sanitary principles than if it were open. Some prefer the gutter which runs along the foot of all the stalls to be an open one, objecting to the cast iron covers, which get in time very smooth. If open, the corner of the gutter at the ground level should be rounded off; this will be very easily done if concrete be used.

The next point we come to consider are the stall fittings, taking of these first the "travises," or divisions between the stalls. These are usually made of wood, than which there is no more comfortable material open to use. Oak makes the strongest, and therefore the most lasting work, but well seasoned inch, or inch and a quarter red pine will be little inferior and will cost less; while yellow or white pine will cost less still, but, being soft, will soon be disfigured by the horses and their attendants. The height

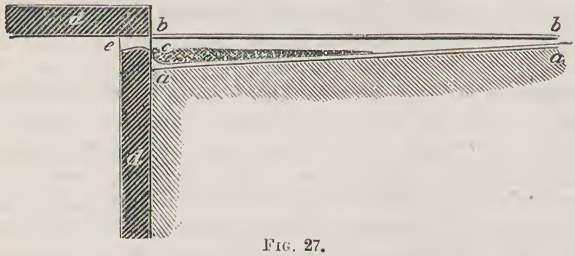


FIG. 27.

of the travis next the heel post is usually about five feet, that at the head nearly seven, this extra height being given to prevent the horses from injuring each other. In place of having this high part solid, it is often made with iron railings, but iron perforated with ornamental openings is found better; these admit the circulation of the air as freely as the railings and the animals cannot get the grip of them with their teeth as in the case of vertical or horizontal railings. The travis boards should be started at bottom from a base or kerb of stone or concrete with rounded edges; this is to keep the board dry, but it may be dispensed

with if the floor is made of concrete. If there is a feeding passage at the head of the stalls, the boarding at the head of the stalls should not be carried up to the ceiling, thus isolating the passage completely from the rest of the stable; but it should be free above the height of five feet, so as to admit of a free circulation of the air about the region of the horse's head.

In some stables the travis boards are altogether dispensed with, and a mere pole or "bale," as it is called, suspended from the head and heel posts, is hung between the stalls. This is, of course, the cheapest plan, and admits of a thorough circulation of the air throughout the stable. But certain dangers and inconveniences, which are obvious, attend its use, and many, therefore, prefer the isolation of the stalls with the ordinary travis fittings. Where the "bale" is used on the Continent, they have generally a contrivance by which it is hung at one end, and which enables the bale to give way if a horse has caught his leg in it. Whether a contrivance of this kind be adopted or not, it is obviously necessary that the bale should be so suspended as to be easily "unshipped" when a necessity for this happens.

The next fittings of the stall to be considered are those connected with the feeding of the horse. The first of these we shall take up is the "hay rack," the position of which has been a fertile source of discussion, some advocating a low, some a high position for it. The latter position—that is, in which the rack is placed at a point above the level of the horse's head—has this advantage, that he cannot get his fore feet into or between the spars, which he is apt—as said by the advocates of high racks—to do in the case of a low rack being used. But all the advantages, we incline to think, are on the side of having the rack placed low, at or about the level of the manger. The spars or rails of the rack may easily enough be made in such a way as to prevent the animal from putting his foot between them. Hay racks are now made of a very compact neat form, in which the hay is eaten from the top, and it is kept pressed against the bars—there placed to keep the hay in—by a hanging weight. The ordinary hay rack should be made with one or two spars or bars at the top, stretched across from front to back; the office of these being to prevent the horse from pulling the hay from out the rack. The bottom of the rack should be at least a foot clear from the floor, so as to admit of the seeds, &c., which fall through the spars, being easily removed. The measurements of the parts generally may be taken from the chapter on Cattle Houses. The front rail of the rack bears at its centre a ring and a staple; through the ring a rope passes, which is connected with the collar of the horse; the extremity of the rope at the manger end bears a weight, which serves to keep the rope tight, and pre-

vents the probability of the horse catching his feet in it. The manger and water trough may be made in the same manner and placed in the same position as those in the stalls of cattle houses. The fittings of hay-rack, &c., just named, are much the same for loose boxes. Where it can be arranged, a good plan is to have these fittings concealed, so to say, behind a wall or partition, that no parts project into the loose box. This will often prevent accidents, but it is not in every stable easily carried out.

We now take up some of the constructive points bearing upon the health or comfort of the horse. And first, as to the walls of the stable. Recent researches into the composition of the foul air, which members of the human race, as well as of the lower animals, give off to the interior of those places in which they are kept, show that there is not merely a chemical decomposition of the fresh air which has been breathed by them, but that there is an organic decomposition which accompanies the chemically deteriorated air. This organic matter which passes from the lungs of the animals, and is also greatly aggravated by the organic matters rising from their excreta, and of the dust and dirt always attendant upon places of this kind, attaches itself to the walls and fittings, and, can at times, as in much neglected cases be collected in considerable quantity. To lessen the chances of disease arising from the presence of this organic matter, all the parts of the interior of the stable should, as much as possible, be made of materials presenting such a surface as will reduce the chances of absorption to a minimum, and at the same time facilitate their thorough cleansing. Hence, the smoother the wall surface is the better, and this smoothness can be obtained in a variety of ways known to the architect. Some of the more recent applications of cements give beautifully smooth surfaces, which are, at the same time, harder, and not so easily chipped off as stucco, which gives smoothness enough. There are ways, however, of imparting hardness to stuccoed surfaces which are more worthy of the attention of the builder than has yet been given to them. Glazed tiles at once suggest themselves, although their price in many cases is prohibitory of their use. This, however, applies chiefly to those kinds in which the colour is white and pure. Although well-pointed brick walls, with their surfaces white washed frequently, cannot be cleaned by the mere rubbing down with a wet cloth or mop, like the surfaces of glazed tile, still, such ordinarily-treated walls will be found on the whole healthy, and will not absorb much of the decomposed constituents of the foul air of stables. It is the non-absorbent quality which makes iron fittings for stalls so valuable—apart altogether from their durability; but presenting, as they do, cold surfaces, against which the horses may lean or lie, they are not liked by many practical

men, who prefer timber fittings, which, as we have before said, are at least comfortable. If the timber is of good quality, the surface may be stained once, afterwards polished with a polish in which beeswax is the principal ingredient. This will prevent, to a large extent, the absorption of the matters already alluded to. The new "silica" paint is highly spoken of, as giving a beautifully white and polished, or enamelled surface, and it possesses also the great advantage of being cheap; a little dearer than ordinary paint, but going much further.

The conventional form and method of making the windows of stables is very well known, the upper part (*a a*, Fig. 28) alone being glazed, the lower part (*b b*) being formed of dead wood. The use of this lower part is to afford a space inside upon the sill (as *c c*), on which a number of articles useful in a stable may be placed without involving the necessity of their removal every time the lower window was opened or closed, hence the reason why the lower part is not glazed. To admit of fresh air, however, being supplied, this lower or dead part is provided with a series of slots or narrow openings (as *d d*), against which another series of slots slides, so that the slots may be opened fully, or partially closed, as desired. This is shown in Fig. 29, in which *a a* are the solid parts of the inside "dead wood" (*b b*, Fig. 28), *b b*, the openings in this; the solid parts of the sliding slots are shown at *c c*; the openings at *d d*; as shown, no air can get through the openings *b b*; but if the outside slots are moved (as at *e* and *f*) the opening (*e*) is left quite free for air to pass in. In Fig. 30 the slot is partially open, admitting air through a part only of *g*; the outside slots are fixed to a frame, which slides in and out in a recess or cavity made in the wall; the lower part of the frame is, in superior work, provided with small wheels running in a groove in the sill; a more simple method is shown at *i* and *j*, the rounded lower edge of the slot frame (*i*) running in a hollow (*j*). Fig. 31 shows a stable window much used in the north; in this (*a a*) the upper part only is glazed to the depth of 2ft.; shutters (*b b*) are placed beneath this, and below all is the dead wood part (*c c*). If the windows be numerous enough, and the upper or glazed part be large enough, there can be no objection to this window; usually, however, the light afforded to stables is

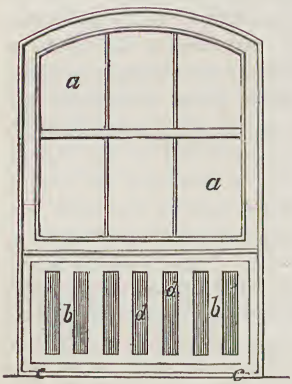


Fig. 28.

too small in amount, and all physiologists will affirm the principle that

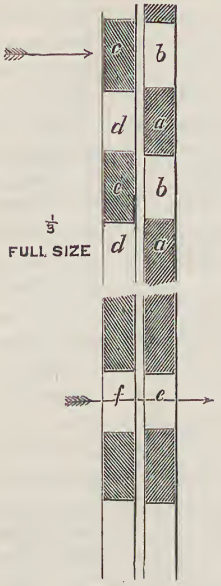


Fig. 29.

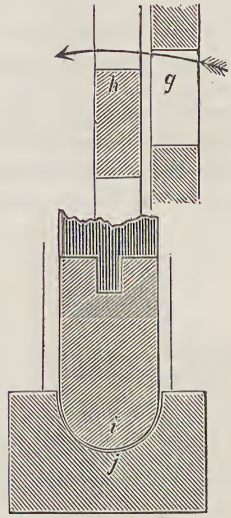


Fig. 30.

abundance of light is essential to good health. Further, the only reason urged in favour of this window, namely, that its sill affords space for putting away sundry things, may be said to be a bad one, inasmuch as the place is too often made into one for "lumber and dirt" of all kinds. By making the whole window light, and placing a recess in the wall below, which may be shelved, all the advantages will be retained, and others obtained which the old plan has not. An excellent form of window is that shown in Fig. 32, in which the lower half is hinged right and left, opening in the centre (*a*) like a "French" or "casement" window, and the upper half is swung in the central part (*b b*) as a centre. At *c d e* the uses of these

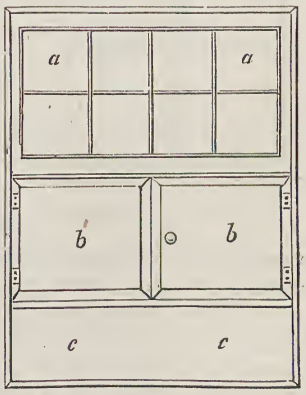
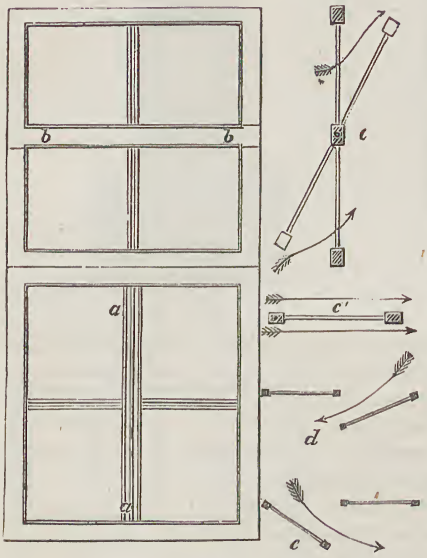


Fig. 31.

various parts as ventilators are illustrated; the diagrams at *c c* show how the swivelled upper part (*b b*) can be put into various positions, *d* and *e* showing the lower halves, and how the air is thrown either to the right or left as desired. The objection to the upper or swivelled part (*b b*) of this window is that the air is apt to be driven in upon the hind quarters of the horses if placed at the front, and *vice versâ* if placed in the back wall. This objection is got rid of by doing away with the central swivel (*b b* in Fig. 32), and substituting for it a hinge at the lower edge of the upper half (as in Fig. 33). This can be kept in any position by the cord and weight attached, and the air in this case is always thrown up in the first place towards the ceiling. Another form of window is the horizontal rolling window; this being longer than deep or broad, and sliding in and out in a cavity made in the wall. This form is readily opened to admit air, but its course cannot be regulated as in Fig. 32.



Fig, 32.

Doors of stables are of two kinds: first, the sliding or rolling; and second, the swinging. In the first the door—if it is in an outer wall, and that wall be thick enough—slides into a cavity made in the wall; or it may slide past the wall, either inside or outside. This door always gives of necessity a vertical opening—no matter how narrow it may be—extending from top to bottom, and thus admitting air along the floor level. This is a great disadvantage; and another possessed by this door is it cannot be so easily shut as a swinging door, nor made self-closing like that form, and must therefore be left to the carefulness of the men to see that it is closed; one result of this being that doors of this kind are often left open when they should be shut. Doors of the second class being cut horizontally into two equal parts, the upper half may be left open while the lower may be kept closed; an arrangement useful in pre-

venting air from getting access to the legs of the horses. In loose boxes and in "infirmaries" doors of this kind should always be used, in preference to the sliding or rolling doors. All parts which can be rounded off should be so rounded, and all the fittings made so that no projecting part be met with. This rule should have no exception, even in the case of bolts, handles, and latches. All of these are now made and can be fitted so that they will be "flush," or even a little below the surfaces to which they are attached; or if any projecting parts cannot be dispensed with, a very little forethought will show how easily these may be so curved that they will present no angular parts which will easily catch. Doors should all be made to open outwards, never inwards, especially in loose boxes, where an animal may be behind the door when it is opened. Like ordinary windows, doors of stables are usually made too small. The minimum width should be 3ft. 9in., the height 7ft. 6in.; but these dimensions may be increased a few inches with manifest improvement. Let it always be remembered, in making any arrangement for horses, that they are animals having a highly nervous organisation and are easily frightened, and, when once frightened, their excellent memory tends to keep it always with them; so that, if a horse, for example, comes up against a narrow door, and hurts himself or gets frightened, he will be afterwards always timid in passing through that door; and in the case of a low door the evil may be as great, for with it a spring or curvet at the moment of entering might be dangerous, which, with a high one, would be innocent in its effects.

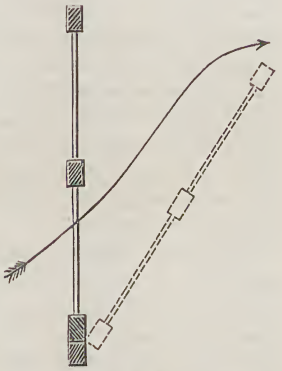


Fig. 33.

It will be observed, in Fig. 18, that a separate room or store for the hay is provided. This is an excellent arrangement, and should always be carried out wherever it can, in preference to the system, too often adopted, of having the hay in a loft over the stable, as in Fig. 23. The fresher the forage is the better; and it cannot be so fresh if placed in a position where the exhalations from the stable below gain access to it, as they will do, more or less extensively, if kept over the stable. Of course, where there are lofts or other apartments, in the second storey, as in the plan in Fig. 23, there can be no open roof adopted; and this "open roof" question is one which has been discussed with great keenness. When we come to discuss the general question of ventilation at the end of

this chapter, we shall there further enter into the subject of open roofs against ceiled apartments in stables.

While advocating the use of a separate room for storing food, we would do the same in the case of the harness, and this for the sake of the harness, as in the other case it was for the sake of the horses. In the plans in Figs. 18 and 22, a separate harness room is provided for.

A word or two as to the site of the stable will usefully conclude our remarks in connection with it. The soil of the site is best when it is gravel, worst, when a retentive, stiff, tenacious clay; this last, indeed, should never be used to build a stable upon, as it is very difficult to get it dry and be kept dry, and damp is one of the worst enemies to his health which the horse has to contend with. Even in the case of gravelly soils, we should, to avoid damp, recommend the whole site, and for some distance round it, to be thoroughly well "land drained," and a catchwater drain put down to embrace the whole site. All the precautions named already, to prevent damp reaching the walls should, in addition, be taken, so that this insidious enemy to health may be met with in all points. A site is a good one which slopes from all sides, leaving level space enough for the stable to be built upon. This will give naturally a higher floor than the surrounding soil, which in itself will be a great preventive of damp. The aspect of the stable forms part of the subject of site; the best is south-east, for the main front, as this gives the maximum of light and sun during the year.

And here we deem this an appropriate place to take up the subject of *ventilation*. A vast deal has been written upon this, and we could easily enough, if so inclined, enlarge upon its importance, nay, the absolute necessity of securing it in all buildings devoted to the housing of valuable farm stock; but we shall spare the time of the reader if we assume that he is convinced of this necessity. And we have shown why ventilation must be combined with cleanliness, so that no foul matter, of whatever kind or from whatever source it may be derived, shall be permitted to remain for any length of time in the interior of the building. Cleanliness will go far to keep the air of a stable or cowhouse sweet and good; but it will not do all that is required. Animals breathe night and day all the time they are in the stable; foul air being thus constantly produced requires to be as constantly removed and its place supplied by pure. How, then, is this to be done, and how much air has to be removed for each horse? Taking the last of these questions first, we can only give approximative estimates. We can estimate with fair exactitude how much a man expires and inspires per minute or per hour. A man takes or makes twenty inspirations or drawings in of air every minute, each inspiration taking a volume or bulk of air equal to forty cubic inches, so that he

requires eight hundred cubic inches per minute of fresh air to supply him with healthy breathing, or in round numbers fifty thousand cubic inches each hour. But each expiration or the amount of the air expelled per minute renders unfit for breathing twice its bulk of fresh air—that is, the eight hundred cubic inches expired per minute contaminates sixteen hundred cubic inches of fresh air, this being nearly a cubic foot (1728 cubic inches), we may say that in round numbers a man requires a cubic foot of fresh air per minute, or sixty in each hour. A horse or cow may be estimated to have six times the breathing capacity or lung space of a man, so that it will require three hundred and sixty cubic feet per hour. To give this amount of fresh air the usual allowance of cubical space in an apartment inhabited by human beings is six hundred cubic feet per individual (one thousand in hospitals), that is, ten times the amount he requires per hour ; a horse or cow, therefore, will require in the same time thirty-six hundred cubical feet. But in the case of man, and, although in a less degree, in the case of animals of the farm, the air is not only being chemically contaminated, but also, as we have shown above, by organic impurities, so that the above amounts will have to be increased to meet the requirements of the case. Some authorities state that one thousand cubic feet per hour should be the allowance per animal. The dimensions of a stable with stalls 6ft. 6in. wide, 9ft. long, and with a dunging passage behind of 6ft., the height of its ceiling being 10ft., will give this amount of cubical space to each horse. But even with this, the air will obviously require to be continually changing, the foul air being carried off as soon as it is generated, its place being supplied by fresh air—this, in point of fact, is "ventilation." To judge from the elaborate statements of some writers, and the still more elaborate expedients by which they propose to effect ventilation, the process would seem to be one surrounded with extraordinary difficulties. One very eminent authority, and a most prolific writer on the subject, named to us that it would take the experience of a lifetime to understand the subject in all its phases. If so, small hope of its practice being successfully carried out in reasonable time. We believe it, notwithstanding, to be much more simple than is generally thought by such authorities. One thing is very clear—that nature helps us very much; and in this, as in other branches of science, we shall find, if only we look for it, that provision is made by which the poisonous products of breathing have a tendency to be carried easily away from the neighbourhood of the person or animal producing them. Air, when it is sent out from the lungs is warmer than the surrounding air as a rule, which has few exceptions in this country; and has therefore a tendency to rise upwards, and, notwithstanding the dictum of some ventilating theorists and practicians to the contrary, upwards it will go if only

allowed to do so. All apertures for its escape should therefore be placed at the highest part of the room, stable, or cowhouse, as the case may be; and we should see that no constructional arrangements be carried out which will prevent this being as easily done as possible. This brings us at once to the question, which, in connection with stables, has been so often discussed—Is the open or the ceiling roof better? We think, upon a fair investigation of the whole circumstances, it will be decided that the open roof is best. True, in some cases, and specially in those of private houses and mansions the having of apartments above the stable cannot well be avoided; although even in these, by a little extra outlay, the stable part of the "outbuilding" might be kept one-storeyed, so as to have an open roof, while the other part might be two-storeyed. The open roof admits of ridge ventilation—that is, a louver-boarded opening at the ridge extending along the whole length of the roof. This is the recommendation of the commissioners appointed by Her Majesty to report on barrack and hospital improvements, and who reported also specially on the ventilation of cavalry stables. The report enters fully into the reasons favour, able to the open roof and ridge ventilation system. With it, for example the effective distance between the ventilating openings in the sides of the stable—whether these be windows or special ventilating openings—is reduced one half, as compared with a stable having flat and impervious roof, in which the effective distance corresponds obviously to the breadth of the stable. Then again, the open roof gives such a distance between the top or upper part of the windows and the ridge, that in accordance with a law of pneumatics, the movement of the air upwards is more constant and certain. Another improvement which the open roof carries with it is the efficiency of the lighting. Anyone who has been in a room lighted from the roof, throwing the light vertically, must have been struck with the thorough way in which it exposes every hole and corner of the room, so that all dirt is at once seen. Now, with the open roof the light is vertical, as a skylight can be introduced along the whole length of the building. To aid in the removal of the foul air, the commissioners recommend air bricks 9in. by 6in., to be introduced in the wall

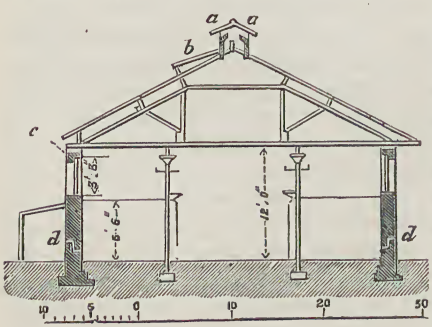


FIG. 34.

all along the eaves, and with their apertures so arranged that the currents of air will flow in the direction of the ridge. Below the eave-ventilating bricks, the windows are placed one to each stall, and made on the swing principle; these are 3ft. 3in. high by 2ft. 6in. wide. The section in Fig. 34 will illustrate a stable with these improved arrangements, in which *a a* is the louvre-boarded ridge ventilator which, with the width shown in the drawing, and the sides 16in. high, will give about 4 square feet of ventilating opening to each horse; *b* is the skylight *on one side of the roof only*, *c* the position of the air bricks. It will be as well to give the plan of this part being in Fig. 35, showing what the commissioners call the "model plan of a stable." It will be seen that the arrangement is the same as we have always recommended, namely, the double stalls

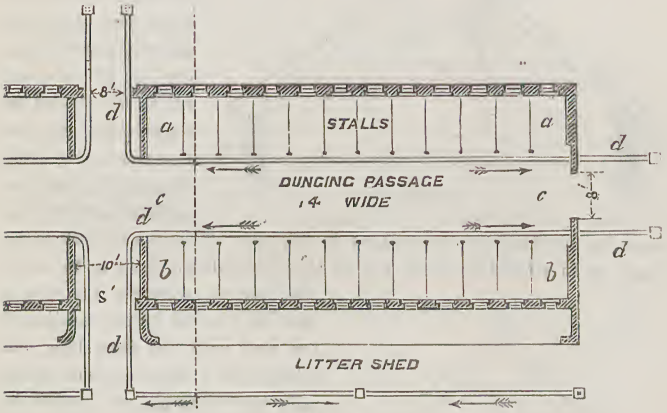


FIG. 35.

a a, *b b*, with the horses' heads to the outside walls, and a wide dunging passage (*c c*) between them.

The commissioners strongly recommend the drainage to be effected by the open drains or channels, *d d* (Fig. 35), these open or surface drains discharging into underground drain pipes, the openings to which should be at a distance from the stable of not less than twelve feet.

The height of the stable in Figs. 34, 35, from floor up to the level of the roof springing is 12ft., up to ridge 23ft. 6in., the total breadth is 33ft., the width of stall 5ft. 6in. These dimensions give a cubical space to each horse of 1605 feet, considerably beyond what we have noticed above—being, in fact, more than 50 per cent. of an increase, with a floor surface or superficial space of 100 feet. There is a door at each end

with two windows, and a door in the centre of each side, all these doors opening in halves.

So much for the methods of getting rid of the foul air of stables as recommended by the commissioners; for the due admission of fresh air, in addition to that admitted by the windows and by the ventilating eave-bricks above the window, a ventilating brick, 9in. by 6in., is placed at the head of each stall, or rather in the space between two stalls; the air is conducted from the outside to within six inches of the floor, the positions being shown at *d d* in Fig. 34. This arrangement is deemed the best, as it not only gives the horse a good supply of air when lying down, but it tends to remove the stratum of foul air which is found to exist near the floor, and which arises from the conditions natural to all stables as regards the excreta. One ventilating brick to each stall will be sufficient where the horse has his head to the wall, as in Fig. 35. The great point to be aimed at in admitting fresh air at this part of the wall is to throw the current towards the angle, which is formed by the meeting of the wall with the floor line, and into which a horse is found generally to "poke his nose" when he lies down.

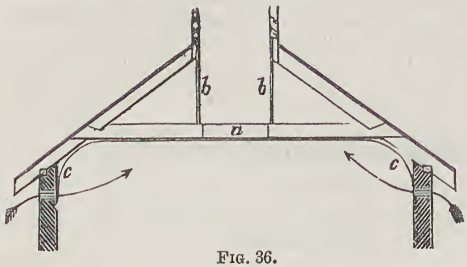


Fig. 36.

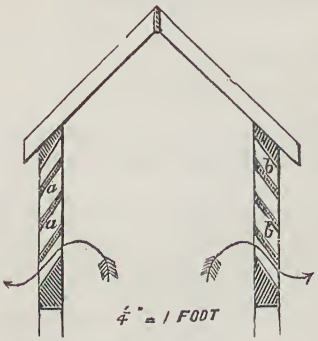


Fig. 37.

So far, then, as regards new stables, these improved arrangements, as recommended by the commissioners, can be easily enough adopted; but in the case of stables already constructed, and with ceilings in place of open roofs, the difficulties attendant upon securing good ventilation are greater, and not always easy to be overcome. Should there be a ceiling, but with an open space between it and the roof, the foul air may be led from the interior of the stable by a shaft or shafts communicating with an opening cut in the ceiling, as at *a* in Fig. 36, *b b* being the shaft, termi-

nated by a louvre-boarded ventilator at the ridge, as shown in Fig. 37. The best angle for placing the louvre boards (*a a*) as stated by a first authority on the subject is 60°, the distance (*b b*) between the boards 3in., and the width of the boards (*a a*) 9in. For a shaft as *b b*, Fig. 36, the louvre ventilator, as in Fig. 36, will be the square of the shaft, the louvre openings being on each side of the square. But the shaft, as *b b* Fig. 36, might be made continuous, forming, as it were, a passage along the whole line of roof, and crowned with a louvre ventilator, as in Fig. 36. Where the ceiling is coved, or where with a collar-beam roof, as in Fig. 36, the ceiling follows the outline as shown by the dotted line, the central shaft system (as *b b*) will be the best, as the air will naturally rise towards the point *a*; and this will be aided by putting in air bricks under the eaves (as at *d d*). If the stable is a short one, one shaft will suffice, if the opening (*a*) of this has an area of eighteen square inches for each horse as the minimum. In ceilings like that in Fig. 36, or coved, the shaft (*b b*) might be dispensed with, and the louvre-boarded ventilator placed on the ridge; if the ceiling could be perforated at frequent intervals between the laths with apertures (as in Fig. 38) the foul air would pass through these to the space (*a a*) above, and from which it would pass off by the ventilator on the ridge. Perforated ceilings, as in Fig. 38, with well arranged outer roof ventilators would form, probably, the most effective method of removing the foul air from an apartment. Where ventilating shafts are used, some prefer them to be so made that they can be closed when necessary. In Fig. 39 we give a sketch of a ventilating shaft (*a a*), provided with a flap or valve (*b b*), hinged at one side (*c*), and resting when closed on the stop (*d*). The valve is opened to any required degree by the chain, wire, or rope (*e e*) passing over the pulley (*f*), and over a second pulley, so placed that the chain can fall from it vertically to some convenient place in the stable.

Fig. 38.

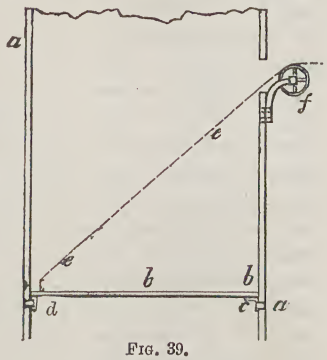


Fig. 39.

Where the ceilings are flat there is more difficulty in removing the foul

air by means of shafts, as in Fig. 36, the air having a tendency to stagnate in the corners; for this reason a shaft is put at each corner. This latter arrangement is absolutely necessary where there is an apartment above the

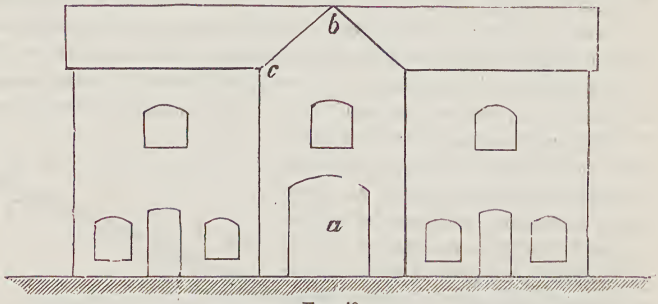


Fig. 40.

stable, no central shafts being in such cases practicable. The shafts should be provided at their upper termination with a ventilating cap or cowl which will aid the upward current, and prevent down draughts. To admit the necessary quantity of fresh air to the interior of stable already constructed, air bricks should be introduced—as already described—near the floor level. The report to which we have before alluded recommends the doors to stop short of the floor some few inches, so as to admit fresh air through the openings thus made. We have elsewhere suggested the plan of providing the door with the lower panels perforated, or they may be made with movable louvres, which could be closed or opened as desired. Infirmary stalls or loose boxes should have a larger cubical space given to them. The "model plan" for an infirmary stall, recommended by the commissioners, gives about 2000 cubic feet for each horse (1900), and of

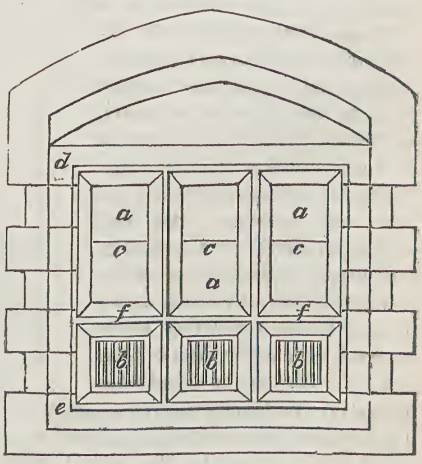


Fig. 41.

ground space 137ft. superficial. The dimensions being: total width of apartment, 21ft.; length of the stall, 9ft. 6in.; breadth of dunging passage, 11ft. 6in.; width of stall, 6ft. 6in.; height from floor to spring of roof, 11ft.; total height to ridge, 17ft. The ventilating arrangements are the same as in Fig. 34, but with the addition of a course of air-bricks in the wall (near the floor) opposite the stalls. Each stall has a swing window and a window in the wall opposite the stalls.

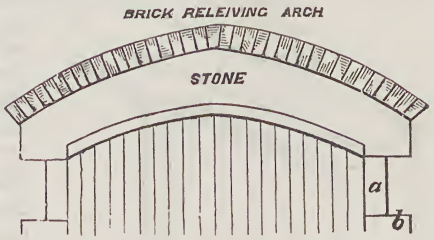


Fig. 42.

There is also a continuous skylight along one side of the roof. The "infirmary loose box" is 17ft. by 12ft.; height of wall, giving with the slope of the roof, 2700 cubic feet to each box or animal; and a floor space of 204ft. If there

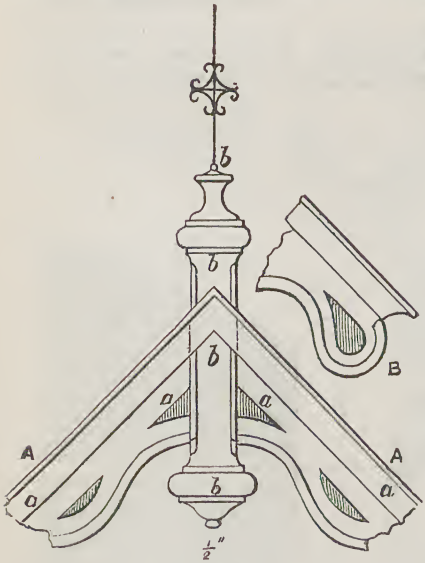


Fig. 43.

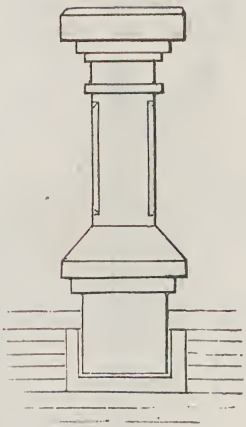


Fig. 44.

be more than one loose box, the partition between them should be carried up to the roof.

We might here enter upon the subject of the external or architectural

design of stables, more especially those connected with private mansions; but this hardly comes within the present scope of our chapter. We shall fulfil its requirements, and give a practically useful conclusion to this part of our subject if we add a few illustrations of door and window drawings, &c., suitable for stables, &c. In Fig. 40 we give the block elevation of the stable in Fig. 22 (drawn to a scale half that given in Fig. 22). In Fig. 41 we give the external elevations of stable windows —*a a a*, the glazed part, swivelling on the central bar, *c c*; *b b b*, the dead wood part, with ventilating plate (see Fig. 28). For the cottage part of the house the windows will be of the same design; but the part between *d* and *e* will be wholly glazed, the "transom" (*f f*) dividing the window space (*d e*) into two equal parts. In Fig. 42 we give the "head" of the door-

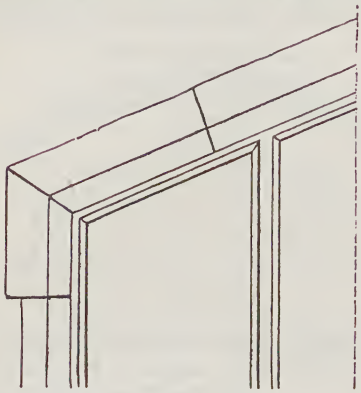


Fig. 45.

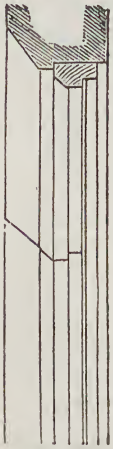


Fig. 46.

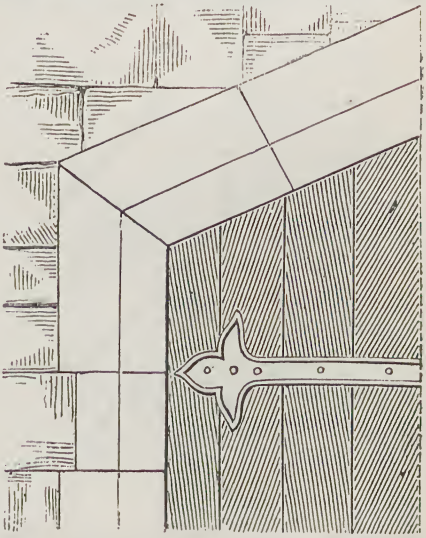


Fig. 47.

Fig. 48.

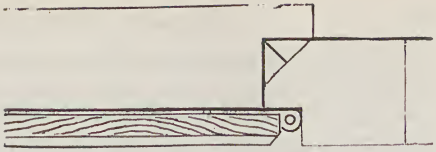
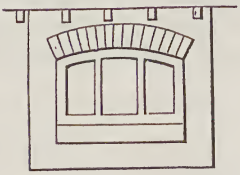


Fig. 49.



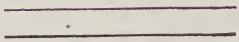


Fig. 51.

Fig. 50.

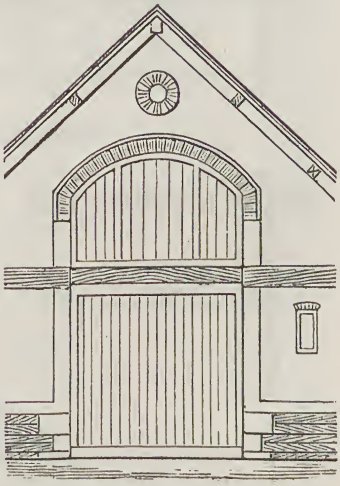


Fig. 52.

way, as in Fig. 40, the quoin stones being represented in the ground line. In Fig. 43 we give at A A the upper termination of barge board (*a a*), with hip knob (*b b*) adapted to the gable (*b*), Fig 40 ; and in B, Fig. 43 ; the lower termination of *a*, at the point *c*, in Fig. 40. Fig. 44 is a design for the chimney in Fig. 40. In Fig. 45 we give a design for a window head of simple character; in Fig. 46, vertical section of ditto ; in Fig. 47, elevation of head of door with ornamental termination to hinge ; in Fig. 48, vertical section of ditto ; and in Fig. 49, plan of ditto. In Figs. 50, 51, and 52, we give sketches of doors and windows for stables of a plainer character ; the shaded parts are of brick, the other parts of stone.

The Calf House.

THE calfhouse, for obvious reasons, is placed next the cowhouse, and this, whether the plan of rearing the calves by allowing them to suckle, or that of feeding them by hand, be adopted. The calf house is divided into small inclosures, technically called "cribs," or

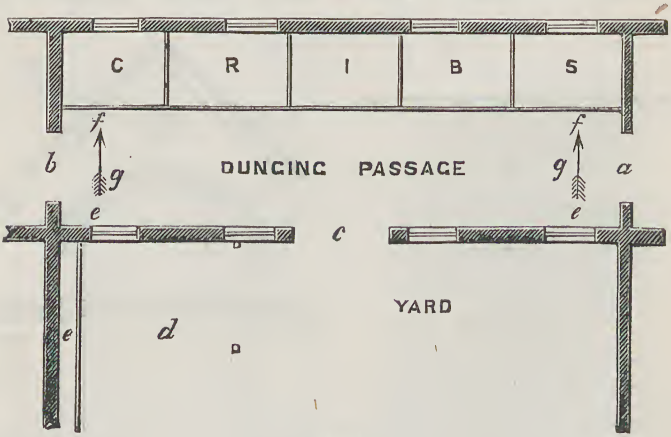


FIG. 53.

"pens." These may be arranged as in Fig. 53, in which one row only is placed against the wall ; or as in Fig. 54, in which there are two rows, with feeding and dunging passage between them. As a passage for

getting round the cribs may be useful, in times of sickness especially, a third arrangement may be adopted, as in Fig. 55, in which this passage or space is placed between the cribs and the walls. In Fig. 53 *a* is the door

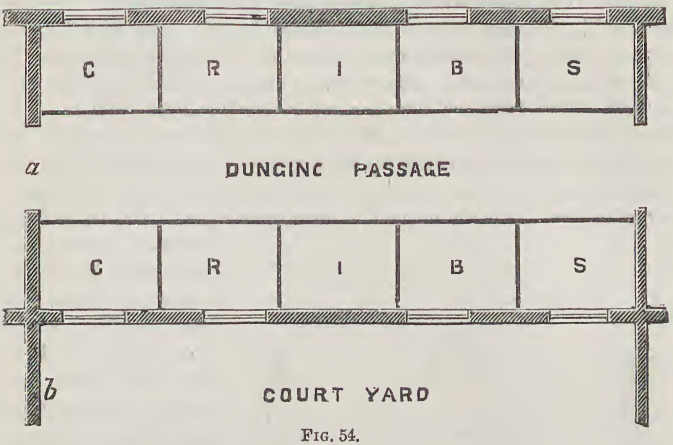


Fig. 54.

to the cowhouse; *b* that to a food store; a central door (*c*) leads to an open yard, one side of which is, or both sides of which are, provided with

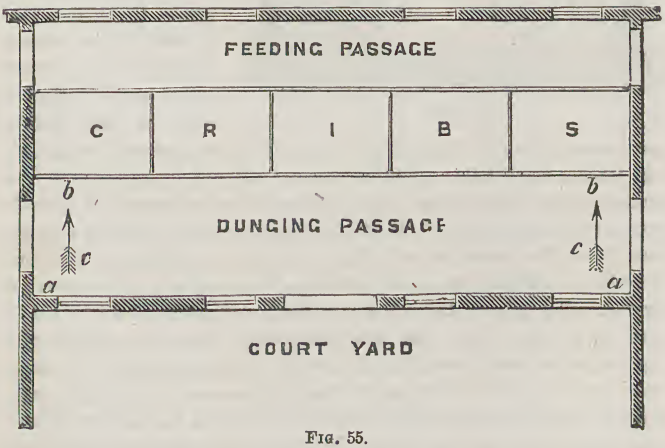


Fig. 55.

shelter sheds, of which one is shown at *d*, with feeding trough (*e*) for the older calves.

The other arrangements are indicated sufficiently by the drawings in Figs. 54 and 55. In Fig. 54 the calves will, however, have to reach the yard by coming round from the door (*a*), and through a door or gate in the wall (*b*) of the courtyard, inasmuch as, by making a central door (as at *c*, in Fig. 53), the space of a stall would be lost. Fig. 56 gives part cross section of the arrangement in Fig. 54. The calfhouse should be well ventilated and well lighted. Some prefer to light from the roof entirely, others from the sides, as in the drawings Figs. 53 to 56. The windows (as shown in section, Fig. 56) are placed above the level of the cribs, and they are made after the manner described and illustrated in the chapter on stables. The details of ventilation will be found in the chapter on stables. It is the opinion of some feeders that dark, or at least darkened, houses are better fitted to aid the feeding processes, and they, therefore, do not agree with the rule to have the houses well lighted. In cases where the calves are to be quickly fattened for the butcher, it may, perhaps, be as well for the houses to be darkened, as under these circumstances they will fatten more rapidly than if kept in well lighted apartments, in which they will be more frisky and restless; and physiology teaches us that this condition does not aid, but retards the fattening process. But if the calves are to be reared for the purpose of breeding from, or for the raising of fat stock, then the more naturally they are brought up the better animals they will make. In this case, the house in which, at the early stages of their lives, they may be kept, must be well lighted, well aired, and the calves must have also plenty of exercise in the yard; and, when turned out into the pasture field, they must not be exposed to inclement weather, than which there is no plan of treatment more cruel and costly. To provide them with means to avoid cold, damp, and wet weather, shelter sheds should be erected in the pasture fields, to which the calves can have access. In a succeeding chapter we shall have remarks to give on the subject of "shelter sheds" generally.

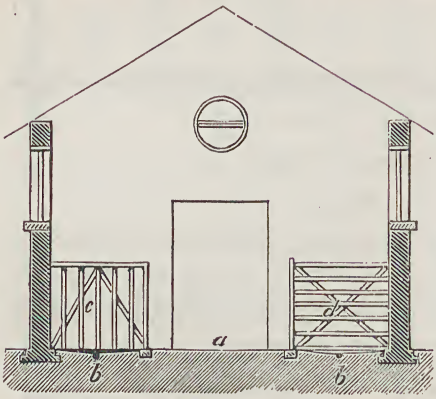


Fig. 56.

The calfhouse (see Figs. 53, 54, and 55) should be laid out with a well-

made floor, for which there are various materials at command. Of all those employed, we prefer concrete made of Portland cement. The floor should not be laid out uniformly of one level; but, when done properly, it must be laid out in compartments corresponding to the position of the cribs, each having its own appropriate contour and section. The dunging passage of the house in Fig. 54 (shown in section in Fig. 56 at *a*) must be rounded off from centre to the sides, thus leading off all moisture right and left to the central space of the cribs. In the arrangement in Figs. 53 and 55, the dunging passage must be of a section or contour so that it slopes slightly from the wall (*a a*, Fig. 55; *e e*, Fig. 53) to the cribs (*b b*, Fig. 55; *f f*, Fig. 53), in the direction of the arrows (*c c*, Fig. 55; *g g*, Fig. 53). The floors of the cribs will best be made by making them converge or slope towards a point in the centre (as shown in Fig. 56), at which point (*b*) there should be a drain tube leading to a trap placed near the outside wall, and from which the liquid is to be conveyed by drain to the liquid entrance tank.

The dimensions of the "cribs" vary; according to the opinion of various authorities, the minimum should be 4ft. square, the maximum 7ft. A rectangular form is perhaps best, as shown in the plan in Figs. 53, 54, and 55, the length being 6ft. and breadth 4ft., or 4ft. broad and 7ft. long. An *average superficial* area for each crib to contain one animal may be taken at thirty square feet. The cribs are not divided from each other by solid travises or divisions, but by open brattice or lattice work, as shown at *c*, or as at *d* in Fig. 56. Each crib must be provided with a small manger and drinking trough. In some cases these are fixtures, being fixed to the wall in the corner of the crib. Some feeders prefer to use altogether movable vessels, these being taken into the crib at feeding time, and removed when the animal is finished with the meal. This plan has the advantage that it enables the vessels to be kept more easily clean than when they are fixtures. Like the cross divisions between the crib, the front inclosures are also made of open work, similar to the parts *c* and *d* in Fig. 56. The door is often hinged with the usual iron hinges, but, as the calves have a habit of breathing closely against the woodwork, the hinges rust rapidly. A simple wooden "pin" hinge is therefore adopted with success. In this the upper and lower bars of the door are extended, and provided at their lower extremities with pins, made of hard wood. These go into recesses made in the upper part of projecting pieces of wood, nailed to the upright of the front inclosure.

Some feeders are greatly in favour of sparred floors for calves, as, indeed, they are equally favoured by them for other animals, as fattening stock and pigs. This kind of floor is shown in Fig. 57, in which *a a* is the outside wall, *b* front post of crib, morticed into the stone cill, *c*; *d d*, the

asphalte floor; *e e*, the wooden frame, 4in. by 3in., the interior of which is filled up by various slots or bars, *f f*, leaving a series of spaces, about half to three quarters of an inch wide. This is placed loosely on the floor of the crib, and the animal lies on this sparred surface; the solid excreta

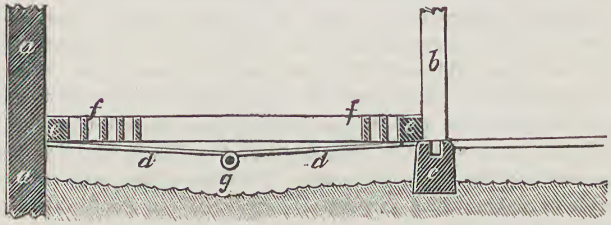


Fig. 57.

partly lying on it while the liquid exuviæ pass through to the drain, *g*; the space below the sparred or false and the surface of the real floor is usually made from twelve to fifteen inches in depth, so as to allow space for the accumulation of the solid manure, this being taken away from time to time by the removal of the sparred floor. This plan may and indeed does save labour, but we prefer to have the space below the sparred floor shallow, or at least, if deep, to have it cleared out much more frequently than is the case when the space is deep and the manure allowed to accumulate. If there is not space in which it can accumulate, the men are compelled to clean it out frequently, and we are of those who believe that the exuviæ of animals are better removed from the place in which they lie than suffered to remain under circumstances in which it cannot

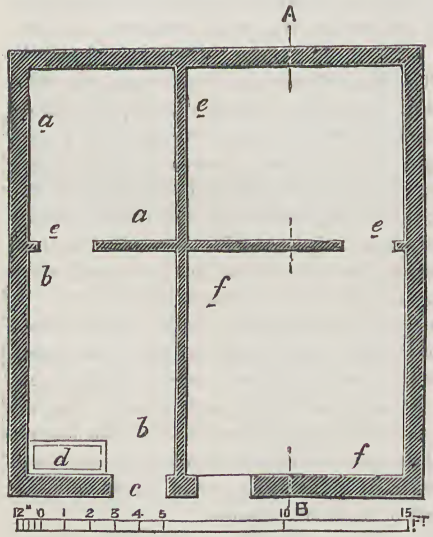


Fig. 58.

be trodden well down—as in this—by the direct action of the animals, as in "Box Feeding."

We now come to the *pighouse or piggery*. The methods which have

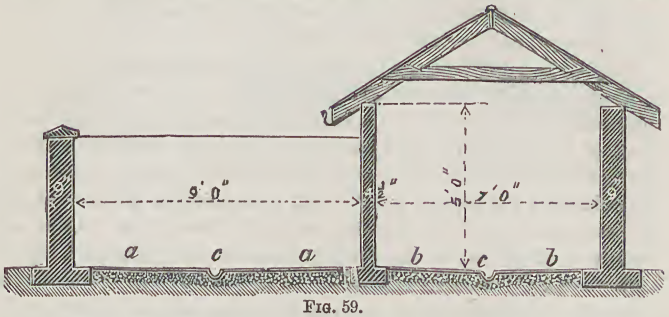


FIG. 59.

been proposed for arranging the cribs are as numerous as have been those in connection with calves. There is this great difference, however, between a pighouse and a calfhouse. In the pighouse the covered "sty" or shed is connected immediately with the small open court. A piggery proper is, therefore, made up of a covered shed, as *a*, Fig. 58, having direct connection with the open yard (*b*). In this yard is placed the feeding trough (*c*), and access is had to the yard for cleaning purposes by the door (*d*). Feeding, or rather the supply of food, is given from the outside, by a spout, or shoot, as in Fig. 60. Fig. 59 is a section on the line A B, in Fig. 58.

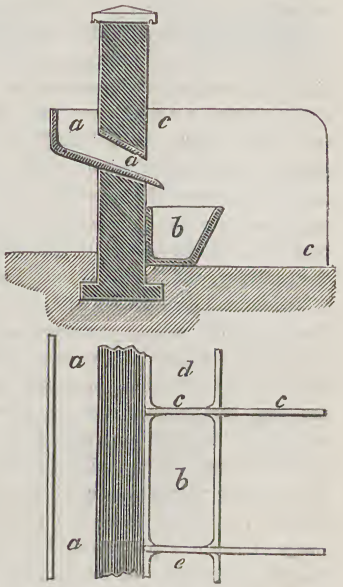


FIG. 60.

As above stated, the methods of arranging a "piggery" are very numerous, and much depends upon the tastes or notions of the breeder, as well as upon the number of animals to be kept. In Fig. 58 the arrangement is one well suited for a small stock. The shed *a a* and court *b b* being provided for young or store pigs, the shed *e e* and court *f f* for the farrow or breeding sow.

The court and shed floors are, if made as in Fig. 58, at *a a b b*, provided with a surface, sloping to the open drain, *c*, this leading to the trap outside the wall; and thence to the tank will be found to answer very well, or the floors may be made, both of court and yard, converging to a central point, as described for calfhouses.

The shed or inner inclosure (*e e*) is entered from the outer court by the doorway (*g*), which is not closed by a door or trap, but left open. In some cases the court yard (*f f*) is covered by a lean-to roof, which has the effect of keeping it dry, and preventing the sloppy condition, which is not certainly pleasing to the eye "which loves order, and the mind which is regulated by the reign of law." Still, some object to the covered yard, and maintain that it is best left open in order to give the animals abundance of air and of the sunlight, in which they certainly delight to bask. But so far as the supply of air is concerned, there will be no lack of it with the sloping roof, as the sides are left quite open and free to the air, the roof being designed only to keep off the descending rains. Certainly, if the physiological principles which are applied to the other animals of the farm, and which influence and regulate their mode of housing be correct, it is difficult to see why they should not be applied to the pig, and, if so, he cannot thrive so well, nor can his food so economically go to the maintenance of his warmth, and the consequent increase of his weight as "dead meat" if he is allowed to wallow, as we have often seen him wallow, in a "half liquid sea" of mud, decomposed food, manure, and filthy liquid. The pig may be anything but a cleanly animal; he may delight in dirt and glory to wallow in filth, and certainly such has been his character from the remotest times, since his habits have been recorded and his nature described; but, nevertheless, not a few believe the contrary, and those have not been the least successful of the feeders of this animal, and we can add to this our testimony, that the pig does most assuredly delight in being cleaned by water dashed upon him, and revels in the glories of the shower bath from a hose pipe. Be this as it may, it rests with those purposing to build piggeries to decide which is the best arrangement for the courtyard, covered or uncovered. The undoubted benefits derivable from allowing the pig to bask and enjoy himself in the sun may still be obtained should the courtyard be covered, by allowing him the run of the general straw or court yard of the farmery; nor will he be the worse, but all the better, for a still wider range of run in a pasture field or common, where he can enjoy himself to the full, after his own fashion, rooting and grubbing in search of food. At the same time, let it be remembered that while basking in the sun is good for pigs, it must nor be carried to excess—or rather, not allowed in the hottest part of the day of the hottest season of the year; for pigs,

having no "coat" or hair on, only a scanty covering of bristles, to protect the skin from excess of heat, it (the skin) blisters and inflames rapidly, adding much to the discomfort of the animal, and in fact doing him injury. Who knows but what the pig is obeying the true instinct of his nature when he coats himself over with mud—when he has access to ponds, &c., where it is in abundance—by wallowing in it, and thus to provide himself with a jacket, so to say, to ward off the sun's heat. This may be the reason of his doing so, not that he loves dirt; for the truth actually is, that the pig is a cleanly animal.

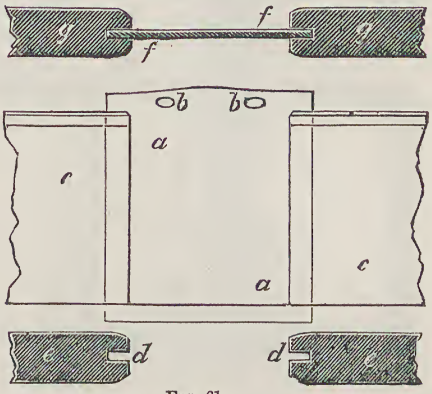


Fig. 61.

The "rooting" fashion of his above alluded to must be guarded against, however, in his house. Thus, an ordinary door, hung in the usual way, will not long withstand his grubbing propensities, and before long a pretty deep hole below it will show the power of these; and, when once this leverage is obtained, the strength of ordinary latch and hinges will go but a small way in preventing him from soon getting rid of the outer door of his stye, and allow him to go forth, to roam "fancy free" in "fresh fields and pastures new." The door as illustrated in Fig. 61 will effectually prevent him exercising the power above alluded to. In this the door, *a a*, lifted by the hand-holes, *b b*, or by handles fixed on the upper edge, slides in grooves made in the sides of the door void made in the wall *c c*, as shown at *d d*, *e e*, in plan; *f f* shows the plan of door in place; *g g*, the side walls. Another form of door we illustrate in Fig. 62, in which *a a* is the wall, *b b* the door—the lower style *c* butting against the stone block (*d*), *e* the line of floor; part side elevation is shown at *f*, which is part of the wall *a* and the floor line is at *g*.

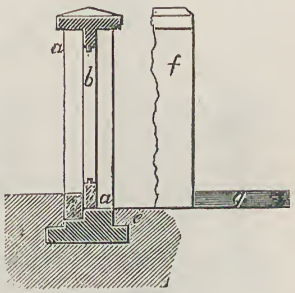


Fig 62.

Sheep Shelter Sheds.

It may be said with truth that the system of feeding sheep under shelter in the same way as other stock are fed, finds more—at all events, has found more—favour on the Continent and in the colonies—and in the latter markedly in Australia—than with us; and it would not, perhaps, be difficult to point out a good number of practical reasons why this

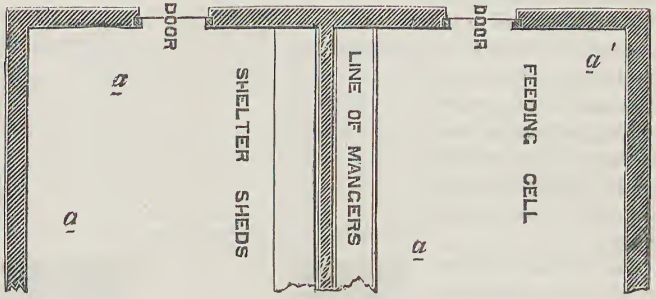


Fig. 63.

should be so, although theoretically it is not easy to confute the reasons brought forward in favour of the plan, founded as these are on the same physiological principles which dictate the sheltered feeding of our cows and cattle. In the following illustrations are given working sketches

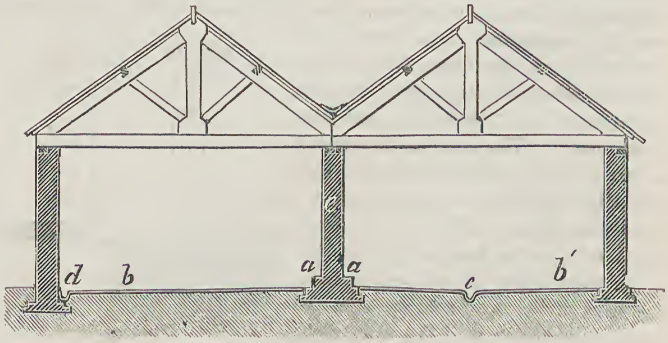


Fig. 64.

showing the arrangement and general constructive details of "sheep shelter" sheds or houses, and of the fittings for the same. Amongst the latter will be found a combined manger or trough and hay or straw rack, the hint for which comes from the Continent, where, as we have

already said, sheep feeding in the house finds high favour with many farmers. The arrangement here shown is what is called "natty" and compact, and is adopted for that plan of house in which the sheep are fed or sheltered in two ways, *a a*, Fig. 63, a courtyard with shed, under which is the feeding manger; or on a covered-in or roofed "bay," with line of mangers. These two systems may be divided by a central wall, a *b b*. In Fig. 64 we give a cross section, in which the two "bays" are used, and these having a roof arranged as a valley roof, in place of one with one span only, as explained further on, in connection with other details of arrangement briefly to be noticed.

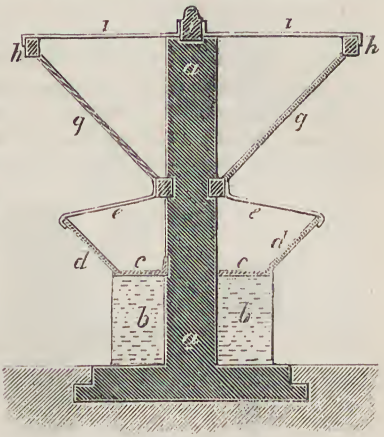


Fig. 65.

In Fig. 65, which is a cross or transverse section of the feeding trough, &c., which rests on *a a*, Fig. 64; *a a* represents the central wall, corresponding to *b b* in the diagram, Fig. 64. At intervals of six feet, as shown in the front elevation in Fig. 66, brick or stone sleepers, as *b b*, are built; these carry the base board, *c c*, of the manger or trough, the front board of which is at *d d*, and slopes outward. This is supported at six feet intervals by the wrought-iron straps or stays, *e e*, which clasp the front of the manger, as shown by the curved end, and are secured at the upper end to the battens, *f f*, built into the wall, *a a*. These project

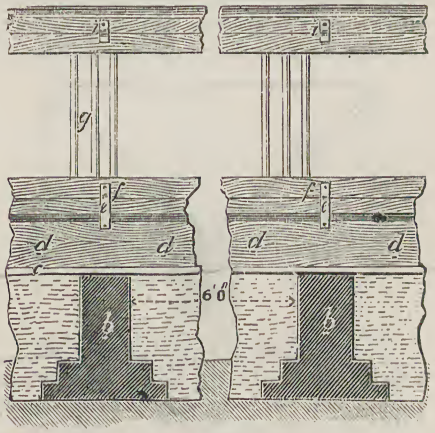


Fig. 66.

from the face of the wall so much as to afford holding space for the front rails, *g g*, of the hay or straw rack, the upper ends of which are fixed to the rail, *h*, this being stayed at intervals by the wrought-iron straps, *i i*, which are secured to the central batten, *j j*, running along the whole length of the central wall, *a a*. The ends of the bar, *h h*, are built into the end walls of the sheephouse, and if this be long, it is supported at intervals by uprights starting from the floor. In Fig. 67 we give a suggestion for two cast-iron troughs supported on brackets, as shown. In all feeding troughs for farm stock it is advisable to have the corners in the inside made angular, as at *a*, Fig. 67, or, what is

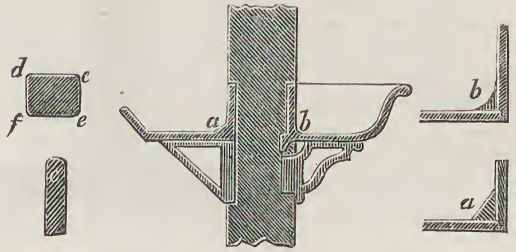


Fig. 67.

better still, rounded off as at *b*. The front boards should have their upper edges also similarly treated, as shown in section at *c*. These are two of those little things which greatly facilitate labour in cleaning out, and the last point in construction is one which often saves the animals much suffering. The difference between a beast coming forcibly in contact with the sharp angle of a post, as at *d*, or a rounded one at *e*, is just the difference between pain inflicted and not inflicted on it. In Fig. 68 we show an alternative method of making the hay rack, this being common to the sheep in both bays. The troughs or mangers are made and fixed as in Fig. 65, on each side of the wall *a a*, Fig. 65, this wall stopping short at the point where the sloping sides of the trough (Fig. 68) starts from.

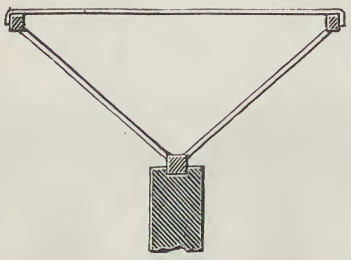


Fig. 68.

In Figs. 69 and 70 we put into working shape, with some modifica-

tions, a portable sheep feeding manger (which could be used also for pigs), which comes from America, where it has been used, we believe, with decided success. It may be made in a cheaper way than in that we have drawn, although, to make it much more plain than there shown would not save much money; but the leading idea of the plan, as the reader will notice, is the getting of two ranges of feeding mangers (as *a a'*, *b b'*, Fig. 69), so disposed that one is on each side of the angular-shaped hopper (*c d*) into which the grain, &c., is fed, and which sheds itself right and left down the sloping sides (*e f*) of the mangers or troughs. All interference of the sheep feeding on the right side (as *b b f*) with those on the left side (as *e a a'*) is prevented by these sloping sides of the hopper (*c c, d d*). Further, some saving of the food is effected by the outside sloping sides (as *a' a*, *b' b*) of the troughs, through the tendency of any food lifted partially out to slide back again to the bottom, which we have rounded. If the trough is made long, strong bars (as *g*) of iron may be made at intervals, and a tie bar (*h h*) should go from end to end at the upper part.

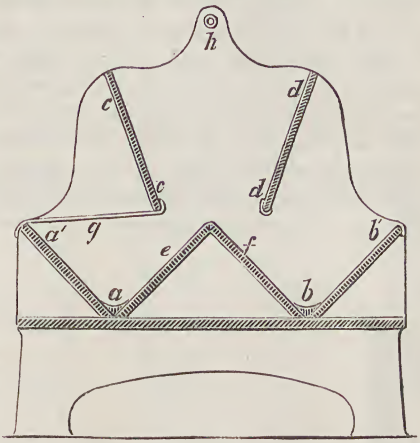


Fig. 69.

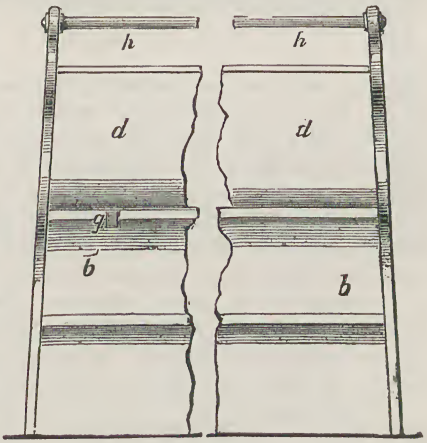


Fig. 70.

In the arrangement shown in plan in Fig. 63, and in cross section in Fig. 64, the floor is shown to be solid: this may be made in any one of the number of

ways now open to the practical man's choice; but we prefer Portland cement concrete, as giving at once the material in which any form or shape can be easiest laid. In Fig. 64 we show two methods of laying out the floor—one towards the right (at *b'*), in which the floor shelves or slopes from both sides of the feeding bay towards a central gutter or drain (*c*). In the other, or towards the left, the bay has its floor sloping or shelving from one side only to the other, at which a drain or gutter (as *d*) is placed. These drains or gutters (*c d*) may be covered with gratings, which, however, should be easily removed. Some prefer open gutters, which are easily swept out.

In Fig. 71 another arrangement of roof and floor is shown, although

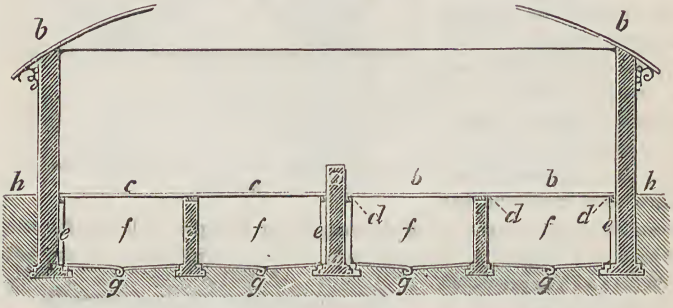


FIG. 71.

the arrangement, so far as the feeding bays are concerned, is the same as in Fig. 63, *a a*, representing the central wall corresponding to *e* in Fig. 64; and *b c*, the right and left hand feeding bays, corresponding to *a a*, *a' a'*, in Fig. 63; in Fig. 71 the roof is in one span, being here made of corrugated iron, of the plates of which only part is shown at *b b*. The important difference, however, is in the floor, which is on the sparred system. In this the sheep, in place of lying upon a solid floor, lie upon a series of spars, between which are left spaces, through which the droppings fall to spaces below the spars. The spars are easily removable, so that the spaces below are emptied from time to time, and the sparred floor surfaces themselves swept and kept clean as desired. In Fig. 71 the spars (*c c*) rest upon oak sleepers or battens (*d d*), these being supported by the brick sleeper walls (*e e*), *f f* being the spaces below into which the droppings fall. The floor of these spaces, as will be seen, slope from either side to central drains (*g g g g*). In Fig. 73, where the sparred floor system is carried out also, the floors or lower surfaces (as *a a*) of the parts below the spars are made curved or

concave. In all cases, in whatever way the floor be formed, it is essential that its surface be hard. There is no greater mistake made in the management of sheep than putting them on soft beds of litter; this litter is, in every sense of the term, wasted, for it does harm to the animals, inducing foot rot, or other diseases of the feet; and it is not liked by them, as may easily be gathered from the fact that if sheep have a choice they invariably lie down upon the hardest surface they can get.

In Fig. 72 we illustrate in plan another arrangement of sheep shelter

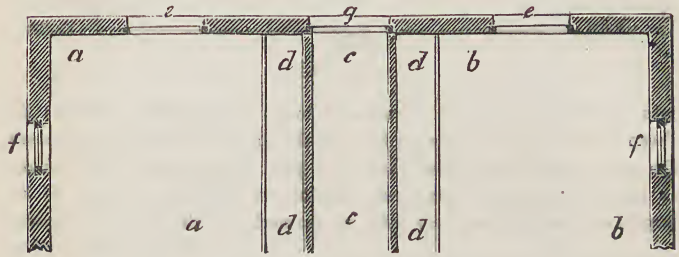


Fig. 72.

shed, in which the two bays (*a a*, *b b*) are divided by a feeding passage (*c c*), from which the mangers (*d d*) are filled right and left; *e e* are the doors by which the sheep enter; *f f*, the windows. Fig. 73 is part

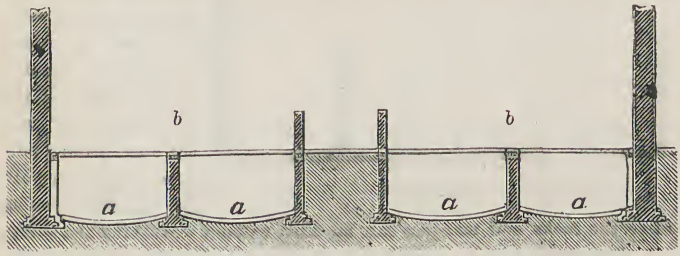


Fig. 73.

cross section of this at end, at a little above the level of the ground level, showing the sparred floors (*b b*) and dung receptacles below, with curved floors (*a a*). The fittings, as in Figs. 65 and 66, will not be available for the central feeding passage arrangement, as in Fig. 72; but it is obvious that the fitting can be modified by simply taking half of the arrangement, as shown in Fig. 65, and putting it up against the inside wall of feeding passage (*c c*), as in Fig. 72. All these plans of arrangement are either shelter sheds in connection with open yards, into which the sheep

can be turned as desired, as in Fig. 74, or simply shelter houses, as in Figs. 63, 64, 72, and 73; the sheep in the latter being allowed to move about only in the bays, these being well lighted and also ventilated from the roof. Probably, the best arrangement is that in which there is a fattening house fitted up, as in Fig. 63 or Fig. 72, with open yards

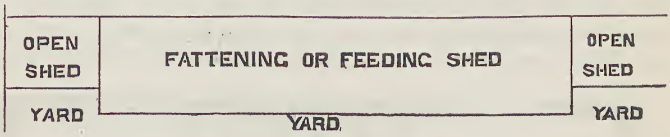


Fig. 74.

into which the sheep can be allowed to go when desired. Where the sheep are not to be wholly confined to the house for fattening purposes, the open yard, with shelter shed, is a good arrangement; the manger, as already described, being very eligible in this case. In one of the largest and most expensively fitted up farmeries of the United Kingdom, where sheep feeding under shelter is carried out, we noticed a somewhat novel feeding arrangement. The rack and manger are put upon wheels, and these run upon rails, these running up the centre of the yard, and out into the open ground outside. By simply pulling out this running frame the racks and mangers can be filled without disturbing the sheep, and when filled they are merely pushed in again. The rails in this arrangement have, of course, to be twice the length of the travelling carriage, half of the length of the rails being outside the shed.

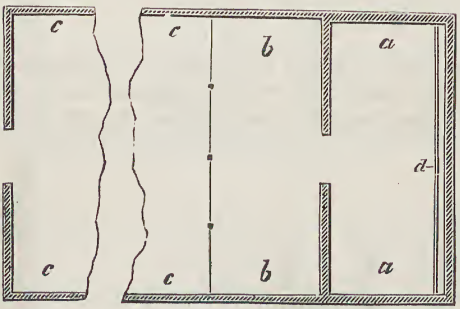


Fig. 74A.

Reviewing briefly the plans we have given, we confess to having a preference for the arrangement shown in Fig. 72 as a fattening house, so far as the central feeding passage (*c c*) is concerned, but with the floor laid out as in either of the ways in Fig. 63; the rack and manger, as in Fig. 65, being simply halved so as to suit the walls of the feeding passage (*c c*). The roof also may be made in one span, as in Fig. 71. This plan would form part of the regular farmery or steading, but

much can be done in affording shelter to sheep in *outlying districts* of the farm, and in no places is it more needed or would its advantages be more strikingly displayed. For such structures see a succeeding chapter.

Some of the best examples of sheep shelter houses are to be met with abroad, and very extensive ones may be seen on the celebrated Britannia farm at Ghestelles, near Ostend; and at what was the Imperial farm at Vincennes. As a rule, open yards form part of the plan of arrangement, these being entered from the houses, which are roofed over. In other plans there is no roofed or wholly inclosed part, open-ended sheds alone being provided, these being connected with the exposed yards. In a third system the three are combined, namely, a closed-in or roofed-over house, with which are connected ranges of sheds, and these,

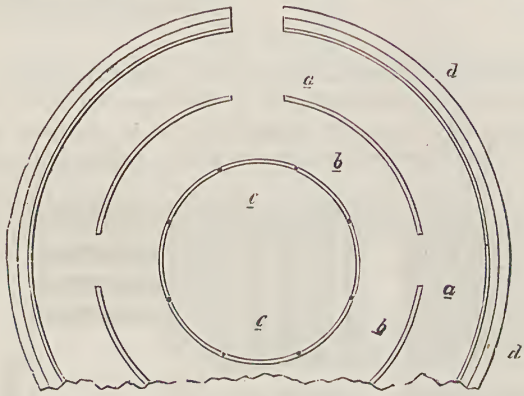


Fig. 75.

again, with open yards. The arrangement of this third plan may either be rectangular (as in Fig. 74), or circular (as in Fig. 75), in which *a a* are the houses, having either span or lean-to roofs; *b b* the sheds, open to the yards (*c c*); *d d* the feeding racks in the house. As hinted at in our last paper, there are two methods of dealing with the floor of the feeding part of the sheep houses—the having it solid, and secondly, having it sparred. A very extensive farmer in one of our colonies, who adopted the sheep shelter system on a very large scale, preferred the sparred-floor system, a sketch of which is given in Fig. 76. The spars were not placed independently of each other, but the sparred parts formed frames, the interiors of which were filled in with longitudinal bars or spars; so that when the manure had to be removed from

below any one frame could be removed wholly, and access obtained to the space beneath, as in Fig. 76. In Fig. 77 one of the sparred frames is shown as adapted for a rectangular house, *a* being the plan, *b* the sectional elevation. Some may prefer these sparred frames to be fixtures, not lifted out each time the manure below is to be cleaned out; in this

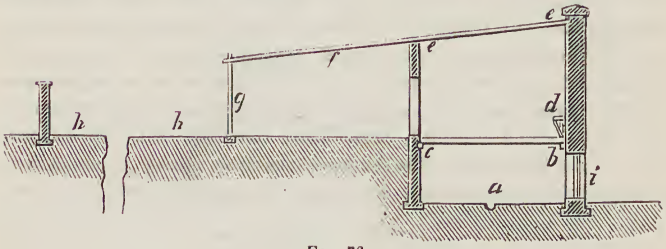


Fig. 76.

case they may be hinged at the top, *a a*, Fig. 77; or they may be arranged as *a*, the right-hand side of the figure, the frame, with the bars transversely instead of longitudinally, as in the other figure on the left, being hinged at the sides to a bar *c c*, stretching from end

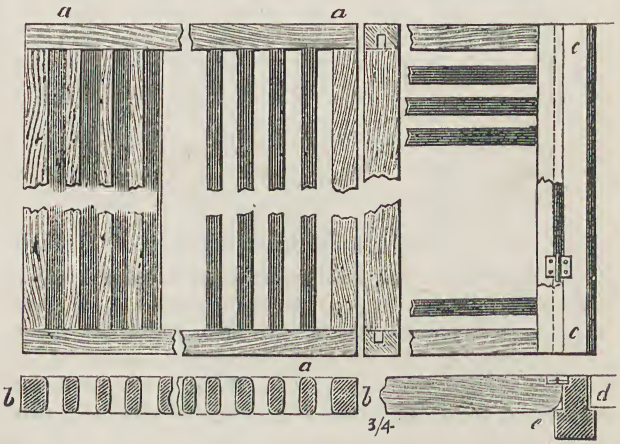


Fig. 77.

to end of the manure opening, and rebated at each side; the rebate at one side, as *d*, forming a resting place for one frame the rebate *e*, the hinging part for the next frame. Or the bars *c c* may be made useful in another way, in cases where divisions are wanted between the sheep,

the hurdles or rails resting upon *c c*. The frames are rested at each end upon sleepers of wood or wall plates let into the walls (*b c*, Fig. 76). The feeding rack is shown at *d*; the house being covered with a lean-to roof (*e e*); extended so as to cover at *f* the open shed *g*, the outer extremity of the rafters being supported on a wall plate, carried by the pillars *q*, beyond which is the open yard. It would seem that in an extensive range of houses the labour of lifting the sparred frames would be very considerable; but we believe the operation of cleaning out the manure space in Fig. 76 was very quickly gone through. But in cases where the ground would admit of it, and where such a plan would be

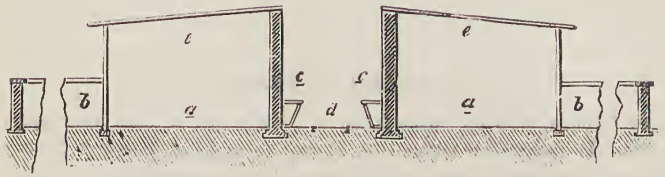


Fig. 78.

preferred, square openings provided with doors, as at *i* (Fig. 76), might be made, through which the dunging of the space *a* could be very readily performed. If the level of the road was such that the carts could be brought up to these doors, the operation would be still more quickly gone through. In Fig. 78 another arrangement is shown, in which shelter sheds (*a a*) alone are used, with the open yards (*b b*), but no covered-in house; (*c c*), the feeding racks filled from a small truck running on rails (*d*), in the centre of the space behind the two sheds. In Fig. 79 part of the line of food racks is shown at *a a*, between the posts (*b b*) supporting the wall plate (*c c*) which carries the upper ends of the rafters (*e e*, Fig. 78) of the lean-to roofs of the sheds (*a a*).

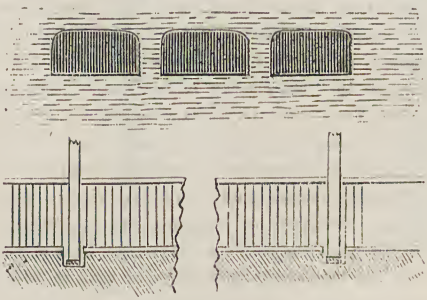


Fig. 79.

These sheep shelter sheds which we have as yet considered, form part of the permanent farming or steading; but we have now to offer a few remarks upon those which may be erected on outlying parts of

the farm. Of late years these "outlying" structures have attracted a good deal of attention, as in districts where the winters are severe they are sure to be of very great service in affording shelter to stock, which otherwise would suffer greatly.

Such sheds might be of two kinds—portable, and fixed or permanent. In the case of fixed sheds a very cheap system of construction might be adopted; and even in the case of the portable ones, by the aid of a little mechanical contrivance, much expense could be saved as compared with the plan generally adopted.

Poultry Houses.

Some farmers, who do business on a large scale, will be very much inclined to resent the notion—or, if not, to smile at it—that poultry have any legitimate claims to be looked upon or considered as "farm stock," and will therefore deem it but a waste of space to give any to a description and illustration of the buildings which they require, if indeed they admit that this term should be applied to the tiny structures which such small stock require for their accommodation. Yet, on the other hand, much may be said in favour of poultry; weight for weight, they yield higher prices than, or as high as, other and more favourably considered stock of the farm. Mr. Mechi has pointed out this in clear and convincing terms, which he generally employs when explaining any subject in which he is interested. Any place is supposed to be good enough to "stow away a few hens;" but poultry, like other "stock" of the farm, will only give results in proportion to the way in which they are reared, housed, and fed; and, if these three points be carefully attended to, we venture to say that poultry will pay.

Poultry houses may be of two kinds: those which form part of the regular farming or steading, an apartment being specially set aside for them in the plan; or they may be isolated structures. These latter are, however, more generally met with in villas and small farms of gentlemen amateurs, where they may be so tastefully designed as to form by no means the least striking architectural feature of the surroundings of the house. Or, as in the case of small properties where a few pigs are kept, they may be attached to and form part of the piggery building, or even of the stable. There is one great point to be gained by having the poultry house form part of the main building of a farmery, and that is, that not only shelter is obtained, but a certain degree of warmth secured.

Now, all who know anything about poultry know that nothing promotes laying in cold weather like a moderate degree of heat in the house in which they are kept. And, as we have alluded to this point, we may commence our few plans of poultry houses by giving one attached to the "boiler house"—that is, in farmeries where the engine is fixed or permanent, as also, of course, the boiler. And, although it may be said that the boiler, not being always in use, as in the case of a factory, but only occasionally, when thrashing, grinding, &c., are going on; still, there is this to be said in favour of this plan of placing the hen-house next the boiler-house—in addition to that important use to which we have already alluded, namely, getting it out of sight and out of the way, on which some farmers insist—that it will be sure to be free from damp; the frequency, at all events, with which the furnace is in use, insuring that; and those who know what poultry rearing is, know how important it is that they be kept in a dry house. The arrangement of the laying and sitting boxes, and of the roosting stage in Fig. 80, in which *a a* is the outside wall of the boiler furnace, is not altogether such as we would like, or, as we shall hereafter show in another plan, may be secured; but it is here done in order to save space, and have the fittings within the narrow space. The front and side walls are shown at *b b*, *c c*, and entrance is obtained from the front wall (*b b*) by (the door *d*), next to which is the window (*e*), which should be as wide as possible. If there be no other building at the side of *c c*, two windows may be made there, as plenty of light is a good thing in a poultry house; and the door may also be made on that side, giving space at the end (*d e*) where a few ducks' nests may be put. The sitting boxes (*f f*) are placed at the back wall (*a a*), each being provided with a nest (*g*); and if a second row has to be placed above, a small projecting gangway or board (*i*) should be in front of them. The size of each box is 2ft.

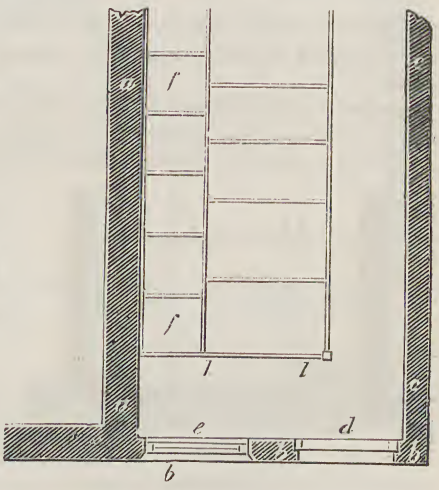


Fig. 80.

cube, with a small door made in the front (as at *j* in Fig. 81). The size here given is for the larger birds; other nests may be made 15in. cube, although abundance of space is better than too little of it. The "roosting stage" (*k k*) is made high enough at the front (*l l*, Fig. 80) to admit of headway being obtained, in order to get at the boxes (as at *k k* in cross section, Fig. 82), and the stage is reached by the hens by a small ladder at the further end of the house. At the outside of the stage a narrow gangway or board should be placed, reaching from end to end of the stage; and, as it will take the slope of the stage (*k k*, Fig. 81), small fillets should be nailed across it, to act as steps, at intervals.

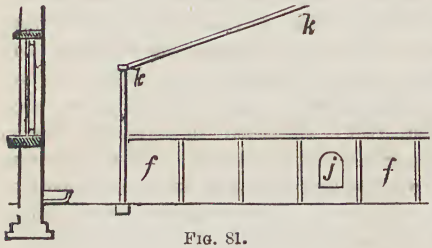


Fig. 81.

We shall have further remarks to make on the fittings of the hen house, so we proceed in the meanwhile to illustrate the plans of arrangement.

Another "out-of-the-way" place in which a hen house may be put up, and at which also some of the "stolen warmth" obtained in Fig. 80 may also be got out from the chimney stalk of the boiler, is shown in Fig. 83, in which *a a* is part of the back wall, *b* the chimney stalk, *c c* one of the end walls; part only of the house is shown, the arrangement being alike on each side of the centre line; *d d*, front wall, with door *e* and windows *f f*. The roosting stage (*g g*) is placed round the chimney stalk, and, by making this high enough so as to obtain head room to go under it, sitting boxes may be clustered round its base. As arranged, the sitting boxes are placed at the ends, as at *h h*. To admit of the birds going in and out during the day, a small hole, about a foot square, should be made in the wall at a convenient place, and at a height of at least 3ft. from the ground, access to this, within and without, being had by means of reversed gangways or ladders; the holes should be provided with doors to close at night, to prevent the entrance of vermin. In Fig. 83, the

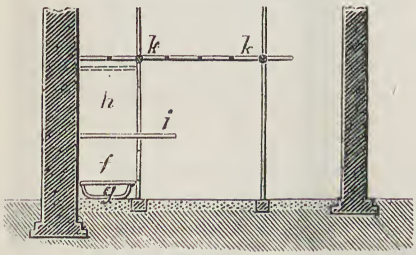


Fig. 82.

dotted lines at *d*, on each side of the door, indicate the position of two entrance holes; two will be better than one.

The objection to the arrangement of sitting boxes in Figs. 80 and 83, is that the eggs must be taken out at the front door or entrance hole; or if the bird be sitting, all necessary work must be by the same. By having the boxes arranged so that a door can be made at the back, all the operations of the hen wife in attending to her charge can be carried on without disturbing the hens, or at least doing away with much of the disturbance of the plan shown in Figs. 80 and 83. The arrangement of a hen house as in Fig. 84 secures this; the boxes can be gone

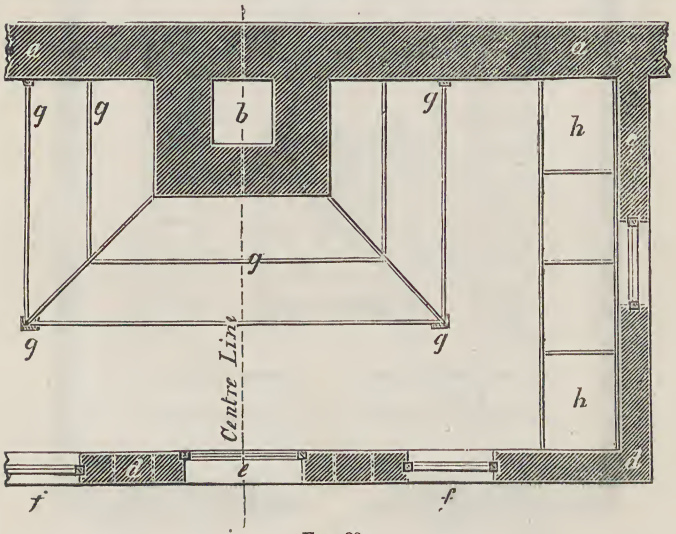


FIG. 83.

right round. No doubt, by increasing the width of the house as in Fig. 80, a passage might be made at the back; but the arrangement of houses may be of such almost "infinite variety," that it is difficult to say which of many is the best; much depends upon individual likings or fancies, and much upon local circumstances and the space at command. It is easy to plan spacious arrangements, but "space" in building is always costly, involving as it does the erection of extra walls, roofing, &c., &c.; so that frequently one has to sacrifice convenience, even in such a "paltry concern as a poultry house," for the sake of economy in materials. So far as the convenience of those engaged in looking after the poultry is concerned, such an arrangement as that

shown in plan in Fig. 84 is much better than that in Fig. 80, even if for no other reason than that the house in Fig. 84 will be much more easily kept clean and sweet than that in Fig. 80; and on the importance of cleanliness in a poultry house no one who knows anything on the subject of rearing the birds requires to be informed. Indeed, of such importance is it that we should recommend all the fittings to be made in such a

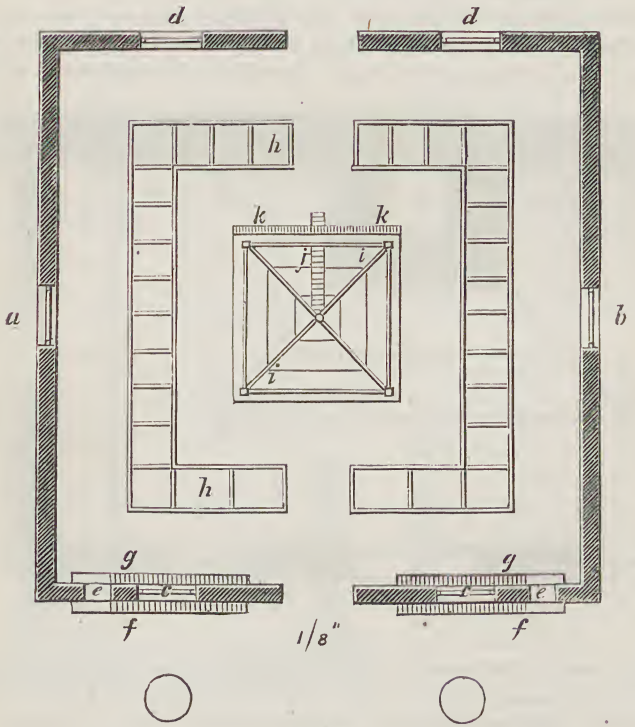


Fig. 84.

way that they may be easily taken down and to pieces, so that each part may at intervals be subjected to a thorough cleansing.

The plan in Fig. 84 may be adopted either in the case of an isolated house, or it may form part of the range of farm buildings. In this case the side lights, as at *a* and *b*, must be dispensed with, unless the house form the last apartment of the range—which is, perhaps, the best plan—and then either one or other of the windows, *a* or *b*, may be retained.

There are two windows to each end, or rather the back and front, as *c c d d*. The "hen holes" are at *e e*, at the front of the house; but, if the back is next to the rick or stack yard, where the poultry have room to stray about and pick up odds and ends of food, these should be at the back.

In the drawing at *f f* are the gangways; others, as at *g g*, being placed

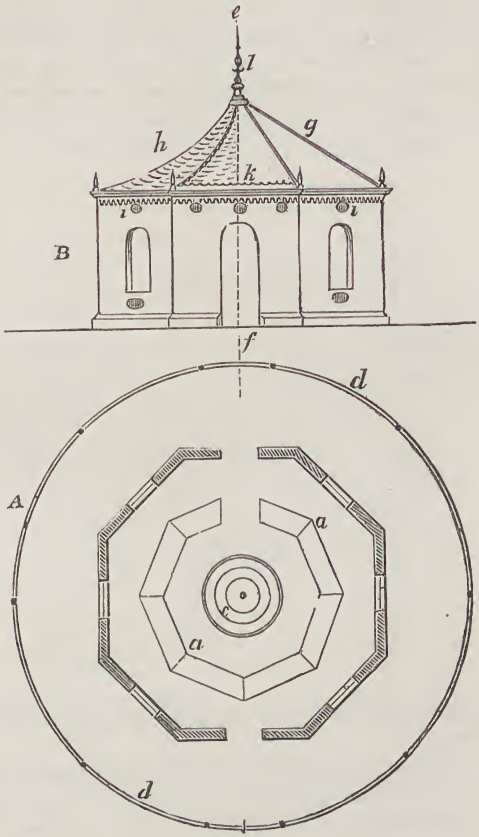


FIG. 85.

inside. The boxes, *h h*, are placed round the interior, and these vary in size. If a few ducks are kept, those nearest the door may have the partition taken out, and the whole space left free. The fronts with doors will in this be also dispensed with; and a low ledge, sufficient merely to keep in the straw bedding, be left in front. The roosting

stage is placed in the centre at *i i*, and this may start from about a foot above the floor level; but cleaning the manure from under it will be facilitated by having head room, as in Fig. 80, in which case ladders, as in *j k k* (Fig. 84), will be required, and a narrow gangway or boarding all round; and therefore some persons advocate the use wholly of high roosting poles or bars; but others, taking into consideration the habit which the birds have of flying down from the roosting places when they wish to reach the ground, and which is said very frequently to result in the birds hurting themselves, advocate low perches or roosting poles. We consider that with confined spaces the perches should be low; high or higher *per contra*. As for walking down the gangway or

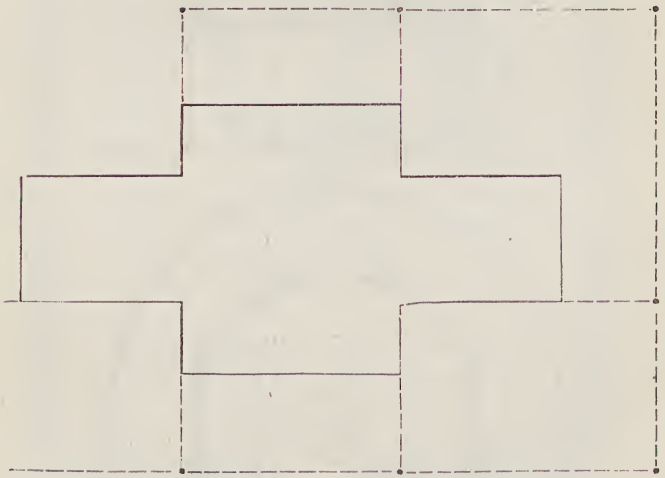


Fig. 86.

ladder, a bird will not do it—or very rarely—if it has the chance of flying or jumping down.

In Fig. 85 we give (in A) plan and (in Fig. B) elevation of a poultry house designed for an isolated situation, and where a trifle of ornamentation or architectural effect may be desired. This is octagonal in plan, a form which admits of a better elevation being obtained than in the square plan, as in Fig. 84. Some space will be lost in the boxes by this form—that is, at the angles, as *a a*; but this may be avoided by making the plan of the boxes square, as in Fig. 84. In Fig. 85 the roosting stage in the centre is circular. The house is surrounded with a wirework fence, forming a circular yard. Two methods of forming the

roof are shown on each side of the centre line *e f*—one, as at *g*, straight; the other, as at *h*, with curved rafters. Where different breeds are reared and kept pure, a very neat structure may be designed for an isolated position, for which we give a suggestion in the rough sketch, plan, and elevation in Figs. 86 and 87, *a* in Fig. 87 being the pigeon house. A very dry place for a hen house is that sometimes chosen for it in the farm steading, namely, at the end of the granary next the yard, so that, by a stair, the poultry can have access to the yard at desire. Being on the second floor, there is no fear of the floor being damp, and for this reason it is preferred by many to one on the ground floor. The internal arrangement may be made according to any of the plans already given, or to any modifications of those considered better.

The question, what is the best kind of floor for a hen house, has given rise to much and to keen discussion, some advocating a hard, others a soft floor—all, however, agreeing in this, that, whether the one or the other, the floor must be so made that it shall be free from damp; hence it is easier to make a hard-surfaced floor dry than it is to make a soft one, and of all hard floors the best and the least pervious to damp is that of Portland cement concrete. For those who hold that the birds should be allowed to carry out their instincts within as well as without the house, then a soft floor must be given to it, one which will allow the birds to scrape away at will in the formation of holes, &c. One made with dry ashes well rammed together, and the upper surface made slightly coherent, will meet the desideratum. The difficulty, however, is the getting of the hard surface of ashes or material which when scraped up by the fowls will form their dearly-loved "dust bath," and at the same time the surface moderately hard; for the means used to secure this will tend to make the floor damp. Taking all things into consideration, as the prevention of damp is most important, and as "dust baths" and "scraping places" can be secured outside, we should be inclined to say, make the floor of concrete.

Another point is the roosting perches. Should the bars or poles forming these be circular and smooth, or many-sided and rough? Following the lessons afforded by the original habits of the birds, we should say that branches of young trees would be the best perching poles.

A "pigeon house" forms part of every farm, or generally does so; a few sentences upon this will embrace all that is deemed necessary to be said in connection with it. Generally it is placed in a small loft, made at the end of the granary, from which of course it is closely isolated, otherwise the contents of the granary and the birds would soon become acquainted with each other; the entrance to the pigeonhouse for the birds being made in the gable or end wall; that for the attendants

being by a small ladder, leading from the granary to the pigeon loft. In place of being thus situated, it may form part of the hen house. If this is an isolated structure (as in Fig. 87), a small tower may be made,

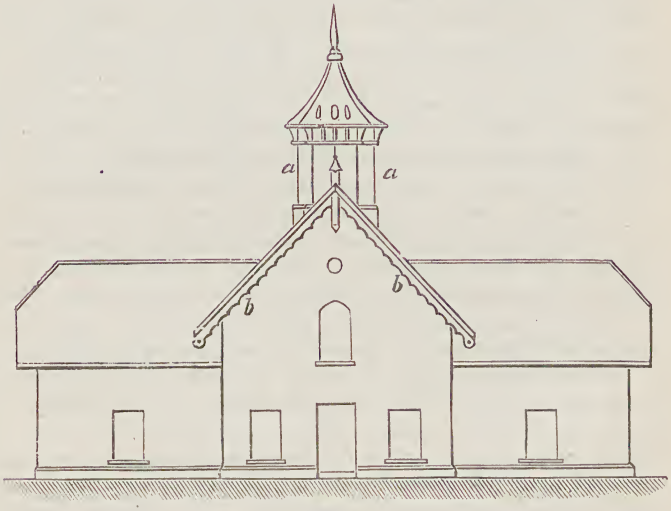


Fig. 87.

as at *a a* in that illustration. In some districts the pigeon house is rather an important building, being isolated, and affording considerable space within its walls. Isolated pigeon houses afford considerable scope for neat design, in place of the conventional lean-to roofed structure so well known as being devoted to those birds.

PART II.—AUXILIARY BUILDINGS.

Machine and Engine Room.

On the supposition that the farmery is one in which the various machines required for the work to be done are driven or worked by a stationary steam engine, the first apartment which will claim our notice is the boiler house. This, in the majority of instances, is either an off-set or an isolated building at the back of the steading, close, of course, to the engine room, which may either be part of the off-set or be under the general roof of the main building.

It is impossible to overrate the importance of attending with the highest degree of carefulness to all points which are likely to lessen the chances of fire being communicated from the boiler house to the combustible materials by which it is too often carelessly, but must, as a rule, be in one way or another surrounded. Safety would be secured in the highest attainable degree if the boiler house, in addition to being well and securely built in the usual fashion, was built also fire proof. This would be perhaps most easily secured by vaulting or arching the roof, and by closing up the entrance by iron doors, which would be best if made to slide or roll along a laterally-placed bar. (See Figs. 89 to 95 further on —Barn door—which will be applicable to this case.) Whether made in one piece or in two, the door should be so constructed as to have a wide overlap; if made in two pieces, the leaves sliding right and left, the overlap would be in the centre, where the doors meet. The best way to hang a door of this kind is to give the bar an extension right and left, so as to roll or slide it either way; right or left, as desired in this case, or, if it is made to slide or roll in one direction only, the door should have a wide overlap over the door cheek, that is, should be made much wider than the door opening. We are inclined to insist upon this complete closing up of the boiler house with a door—the more perfectly it is fireproof the better will the object in view be obtained, inasmuch as we have not seldom seen the sources of danger arising from an open boiler house, especially at those times when the furnace fire is what is called "drawn." At such times it is not the mere presence of

the mass of burning fuel which, being drawn out from below the boiler and allowed to lie in the front of the ash pit, that constitutes the danger; but it arises from the straws and pieces of loose material too often allowed to lie carelessly about, being carried by the wind, &c., into immediate contact with the burning fuel, and by the same or other agencies whirled off to mix with larger masses of combustible matter. To prevent the spread of fire every appliance or constructive detail should be brought into use; and we may say that the actual difference between making a boiler house secure against fire and leaving it fully exposed to all its dangers is but trifling. On large farmeries we should recommend the boiler house to be completely isolated from the rest of the buildings, leading the steam to the engine house where required by underground pipes. The most advanced of all the farmeries we have yet inspected in this department has a large central boiler house, supplying steam not to one steam engine, doing all the work of the farm, but to several small steam engines, each of which is placed in the building with which its work is connected. One great advantage of this system is that the engine is, in the first place, proportioned to the work it has to do, thus doing away with the necessity of working, say, a 12-horse steam engine to do the work of one of 3-horse; and, in the second place, the engine is only worked when it is required, and to do only one kind of work. Of course, this system is only available in large farmeries; but, the tendency of the times is to concentrate in one farm a wide extent of land, and consequently a large amount of work, and thus to necessitate the erection of larger buildings. The difficulty has been raised to this central system of steam boiler supplying a series of small engines placed conveniently to their work, that the steam, carried, as it must of necessity be, in a long range of pipes, must get condensed, and that a great loss will thus be sustained; but this difficulty existed only in imagination. It is an easy thing so to lay the steam pipes that in hundreds of yards the loss is a mere nothing, so to say. In addition to having the boiler house so constructed and provided with doors as described, care should be taken to have the steam pipe passed to the engine house through an aperture no larger than is necessary, care being taken that no wood or other inflammable material be near the pipe. It is quite a mistaken notion to suppose that timber or other inflammable material, such as shavings, &c., require to be placed in contact with very highly heated or red-hot bodies before they can take fire. Experience in too many cases has proved that these and such like substances, and vegetable materials, such as cotton waste and the like, after being thoroughly dried and subjected to temperatures only moderately high, become peculiarly liable to ignition if subjected, from

some peculiar cause, to a temperature only a little higher than the ordinary one to which as a rule they have been submitted. Indeed, if the substances, such as cotton waste, have been saturated, or even partly so, with vegetable oils, they are very liable under such circumstances to spontaneous combustion without extraneous heat. And as regards the use of oil, we should recommend the mineral oil to be used for lubricating purposes, as this, when mixed with cotton waste, &c., prevents any tendency in those to take fire spontaneously.

Next to the boiler house is the steam engine room. This should be well lighted, and not, as is too often the case, so dark that it is impossible to see all the parts of the engine sufficiently well to keep them in the high degree of cleanliness that is necessary. The engine room in many cases is placed on a lower level than the boiler house, necessitating the use of steps to descend into and ascend from it. This should never be allowed, for the engine man, having to attend to both the boiler and the engine, as a rule, is often placed in circumstances in which, while in one or other of these apartments, his presence is required hastily in another. Apart from this, every convenience should be put in the way of work being easily and readily done. The same remark applies to the "machine room," which should be of easy access to the engine man from the steam engine house or room. In addition to being well lighted, it should also be well ventilated, as a peculiarly disagreeable odour arises from the working of the engine and its heated parts, saturated with oil as many of them are. The contiguity of the chimney stack of the boiler furnace affords an excellent means of withdrawing the foul air from the engine room by means of a flue or pipe communicating with both. Some might think this a source of danger from fire; but there is no cause to fear this, and all damages may be avoided by having a sheet of wire gauze. Good, and, for the most of cases, sufficiently powerful ventilation, however, may be secured by having the windows of the engine room made after the manner we have illustrated in our section upon ventilation of stables, &c.

As for the floors, some prefer boarded ones; but as these in time get oil-stained and dangerously slippery, we would recommend either rough surface coated flag or paving stones, or concrete grooved on its surface, which will be better still; this will always look clean, and be, moreover, easily kept clean, and afford a good foothold for the engine man. Earthen floors, which soon get loose and dusty, and which we have too often seen surrounding an engine, are simply abominations which should have no existence in a well-ordered establishment. Where the proprietor has very good taste, the engine room will be kept, as the saying is, "like a drawing room," and many nowadays are; the engine, with its polished

parts bright as steel, all around orderly, and a floor, if boarded, covered with handsome oilcloth; this latter, however, would be more likely for a "model farm" than for one carried on under ordinary circumstances.

The Barns.

We now come to say a few words as to the barn. The barn proper is that part of the steading devoted to thrashing purposes, being differently placed from the straw barn, the purpose of which is the storing up of the straw which is passed from the thrashing machine, and which has no second floor, reaching generally from the floor to the ceiling. The barn proper has two parts, the lower and upper barn, and is generally named or known as the "corn barn," as distinguished from the straw barn above alluded to.

And first, as to the lower barn: the constructive parts of this are concerned chiefly with the floor and walls, so as to render them as much as possible rat and mice or vermin proof, and the fittings, with the doors and windows. Methods for rendering these also vermin proof we may also suggest. We shall take the doors and windows first. The door of the lower barn is generally of large dimensions. In cases where the width of the barn is not great that of the door, indeed, is the same. The door is therefore, as a rule, having few exceptions, made in two halves, or leaves, as they are technically termed, for the more easy opening and shutting of it. Under ordinary circumstances these large leaves are kept closed, and to gain access to and from while the operations are going on, a smaller door (as at *b*, in Fig. 88) is made in the right-hand leaf. This smaller door is also made in two leaves, but while the lower, as *a*, opens in the usual way, that is, vertically, the upper leaf, as *b*, opens horizontally, or is what is called a fall down leaf. When this is opened light is admitted to the barn, and parties can see from the exterior what is going on in the interior, and *vice versâ*, while the lower leaf is closed. The dotted line, *c*, in Fig. 88, indicates the position of the upper leaf when it is down. The leaves of the large or main door may be made in a number of ways. The space behind the "hanging" or hinge "style" (*d d*) and the latch "style," *e e*, may be filled up with plain boarding, as *f f*, or this may be filled in with a middle or "lock style," *h h*, and diagonal stays, *g g*, "stop chamfered," as shown, which will be more ornamental; *i* shows the exterior stay or brace.

Where barn and other doors are very large, the inconveniences attendant

upon them are well known; the difficulty of opening and shutting them in windy weather, and the rapidity with which they get out of repair, hanging loosely on their hinges, &c., have sorely tried the patience of many in carrying on farm work. In view of the above and other inconveniences not here named, but which will be remembered by our practical readers, possessed by large doors, hung on the ordinary principle, it has often struck us as a remarkably odd thing that the sliding door so generally used in warehouses, &c., should not have been more generally adopted in farm buildings. Commercial men have no time to lose, no

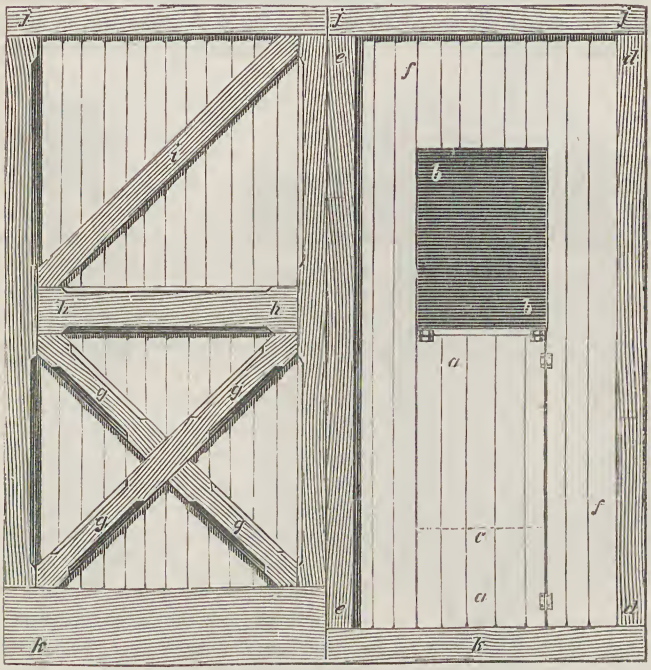


Fig. 88.

extra money to throw away in working, adjusting, and repairing heavy, clumsy, and broken-down doors, hence they adopt a contrivance by which the largest doors can be moved almost as easily as the smallest, and which, when once hung, rarely, if ever, get out of repair.

In doors fixed upon the principle of sliding or rolling there are two methods in use. First, that in which the door is suspended or hung

from wheels or rollers; and second, that in which the door is borne or carried by the rollers or wheels—in both the same principle being at work, namely, reducing the difficulty of moving a heavy weight by sliding it along on a smooth surface on what may be called friction rollers, in the one system these being placed above, and in the other below the door.

In Fig. 89 we illustrate the first of the above-named systems—namely, the suspension or hanging system. In Fig. 89, which is a portion of the upper part of the door, *a a* is part of the upper rail, corresponding to *j j j* in Fig. 88, which we give as a design for a door of this kind, *b b* being the boards filling up the space. To these a strap, *c c*, is fixed, embracing them, as shown in Fig. 90, and secured by bolts and nuts as

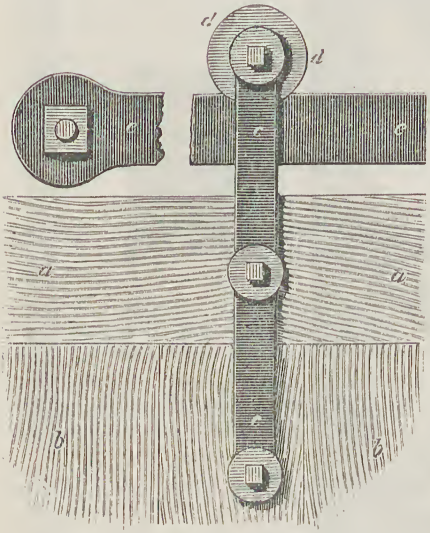


Fig. 89.

Fig. 90.

shown. This strap carries at its upper end a friction wheel, pulley, or roller, *d d*, which runs upon the upper rounded edge of a flat iron bar, *e e*, fixed to the wall, in which the bolt is leaded, and carrying the bar, *e e* (Fig. 89), which is secured by the nut *d*. Where the boards, as *b b*, are not flush with the rail *a a*, the strap, *c c* (Fig. 89), should be secured to the side style, *d d* (Fig. 88). Sliding doors are generally made in two halves, as in the sketch in Fig. 88, one half sliding to the right, the other to the left, and to steady the motion the lower rail, as *k k* (Fig. 88), is made to run in a groove cut in the upper face of a stone sill or step in

front of the door opening; sometimes small friction rollers are added to the bottom rail.

The second system is illustrated in Fig. 91, which also illustrates the employment of corrugated iron, which makes a lighter (and fireproof) door or gate than that made of timber, as in Fig. 88. In this, the second system, the door slides upon and is supported by the rollers, *a a*, Fig. 91, which run upon iron rails, *b*, bolted or leaded to the stone sill, part of which is shown at *c c*. Two iron plates, *d d*, carry the centre stud or pin, *e e*, on which the rollers or wheels, *a a*, revolve, the plates being riveted or bolted at the upper end to the corrugated iron plate, part of which is shown at *f f*, a cushion piece of iron, *g*, being introduced at the point where the plates, *d d*, are secured to the iron. In Fig. 92 we give the upper part of this door, in which *a a* is part of the corrugated iron plate corresponding to *f f*, in Fig. 91. This carries a friction roller, *b*, which slides in a hollow groove bolted to the under side of the sill, *d d*, which sill projects from and is itself secured to the wall, in a line with the sill, *d d*, in Fig. 91. In Fig. 93 we give the plan of a door of corrugated iron made in one leaf, with a central style, as *b b*, made up of two plates of flat iron, *b b b b*, with a solid bar, *c*, to which they are secured by the rivet, *d*, *e*. The ends of the corrugated plates *a a*, butt against the bar, *c*. The side styles of the door are made in the same way. But only up to the point shown by the dotted line, *f*, *g*, do the plates, *b b*, extend for the right-hand style, and up to *h*, *i*, for the left-hand ditto. Doors of this kind are very light,

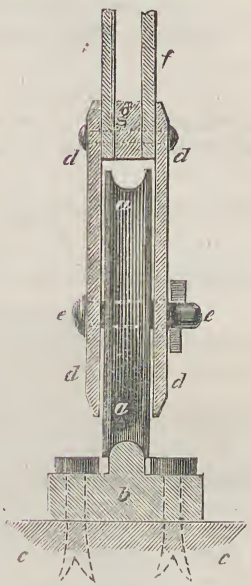


Fig. 91.

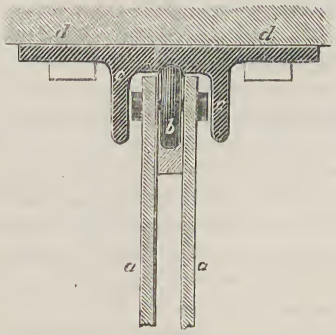


Fig. 92.

and are of course fireproof. The principle may be extended to small doors. Where the appearance of the corrugated plates is objected to, they may be concealed by flat plates of iron or zinc, as *a a*, *b b*, in Fig. 94; or with wood lining, as *a a*, Fig 95, on one side, and iron or zinc on the other. If the wood lining is outside, the heads of the rivets may be counter-sunk, puttied, and painted over, so as to give a perfectly flat surface, if that is desired. This last method of rolling is well adapted to the system in which the leaves slide or roll into recesses or cavities made in the walls at each side of the door void —a neater system than those now illustrated, all the parts of which are outside. There is one feature, however, which these possess, namely, as the parts are always exposed they are easily got at for the purpose of repair, painting, or for oiling the grooves, if necessary.

Fig. 93.

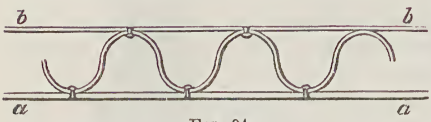


Fig. 94.

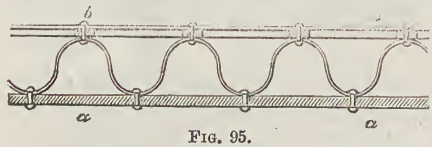


Fig. 95.

The windows of the barn will best be made upon the principle of the window illustrated in our remarks upon ventilation.

We now come to the floors of the lower barn, which are made in a variety of ways, either with ordinary boarding and flooring joists, which is the worst for vermin—or rather the best for them and their marauding purpose—lime or earthen floor, pavements or flag stones, asphalte or concrete; of all these we prefer the last, although asphalte, if *properly* laid down, makes a good floor, but all depends upon the word we have italicised, and what it carries with it being attended to. But, in too many cases, asphalte is laid down by those who really do not know its properties, and how these can best be used to make a thoroughly sound floor; hence the reason why so many floors of this material are utterly worthless and quite unfitted for farm work. Now, it is scarcely possible for a man with any intelligence at all to make a thoroughly bad floor (as bad as a bad asphalte one) of concrete, of which the cement employed is Portland. Moreover, as we shall presently show, it is so easily worked up to the walls that a vermin-proof floor can be secured by its use, and at little or no extra cost. We, therefore, would strongly recommend the

floor of the lower barn to be made of this kind of concrete. But other kinds of flooring may by some be more highly esteemed, such as the boarded floor. We know of no method so good for forming one of this material as that recommended by the late Mr. Stephens in his "Book of the Farm," where the reader will find it described. For obvious reasons, we shall consider the whole subject of making apartments rat proof or vermin proof, taking in other points as well as floors.

The principal points through which rats and mice gain access to the buildings of the farm are the floor and doors, and also by the windows. Walls ought not to be built so badly as to allow of holes in them large enough to admit the vermin. Let us take the case of floors first, as that of the lower barn. If the floor be of concrete much will depend upon the materials of which the cement used is made, for, if these be good, the floor surface, *c c*, Fig. 96, will be rather a tough bit of work for the rodentia to gnaw through to find their way to the upper surface. But in many cases we fear that the cement will not be of such quality as to give the hardness necessary. Nor, indeed, will this always arise from the defect of the cement, but sometimes from the notions of economy of the constructors, who may wish to save the cement; and putting a smaller proportion of it in the concrete will bring about the softness which will enable the rats to force their way through. Moreover, the floor may be made of a lime concrete, which, although not so hard as Portland cement concrete, makes a good hard floor, and, withal, a cheaper one than the concrete. In this case the rats will have no difficulty in getting their way through it. But by taking advantage of the habits of these animals, the cunning of which is only equalled by their hard-working perseverance, we can countermine them, so to speak, and thus: where a wall exists the rats will almost invariably begin to burrow straight down its outer surface, as shown at *d* in Fig. 96, and, in place of going through the wall, they will find it their easiest way to go under the footings and up in the course of the dotted line. But if at *a* (Fig. 97) a course of flat stone be built into the wall and project from its surface as shown, the rats, finding their course

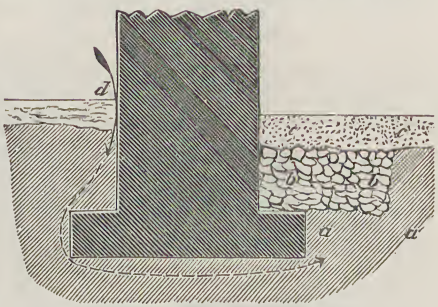


FIG. 96.

obstructed at the point, *b*, will attempt to proceed no farther. If the excellence of the concrete can be relied upon, the outside of the wall at the footings and a little below them might have a layer of concrete. This would prevent the rats from going down from the outside. This arrangement is shown at *a* in Fig. 98; and if amongst the stones at *b*, also at *bb*, in Fig. 96, pieces of broken bottle glass be put pretty freely, the difficulty of the rats making their way up to *c c* (Fig. 96) will be much increased. If, in place of concrete, flags or tiles, or even boards be used as the floor surface, it will be a good plan to form a rebate or channel, as at *c* (Fig. 98) in the face of the wall in the interior, into which the flagstone or tile, *c*, can be inserted. This will serve much in the same way as the stone, *a b*, in Fig. 97, and will, by throwing the joint *d* (Fig. 98) forward, present the solid part of the stone or tile to the rats. It is right to state that we have not tried this plan of having the flat stone, *b*, as in Fig. 97, but we have it on high authority that it is effectual; and, judging from what we know of the habits of the animal, we should say it was likely to be so. It is worth while to be at some trouble to get the better of rats.

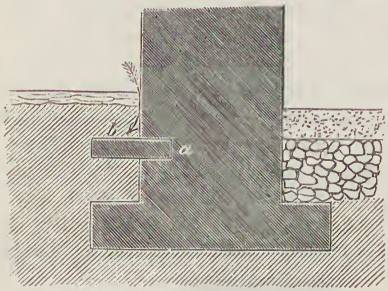


Fig. 97.

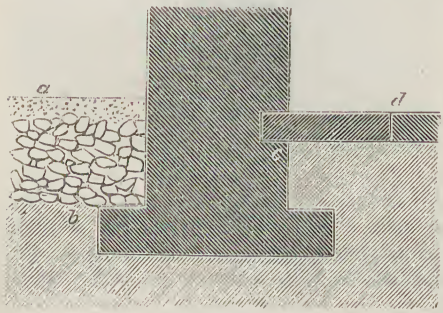


Fig. 98.

The entrances to ground floor apartments should all be made with high sills, equal in height to a common door step, and, to prevent the rats from climbing up the outside, may be provided with a cap like that at *a* in Fig. 99. This may be a little in the way of parties entering the barn, but not much, and a little inconvenience must be submitted to where an obvious good or saving is to be effected. The hood or cap may be made of cast-iron—we have known zinc employed—and it will be well to have the lower part, *b*, rolled under, which will pre-

vent the clothing of parties entering being caught by the lower part. Any rats attempting to climb up the base, *b c*, will be effectually stopped by the part *d*. If the more efficient form of "hood" shown at *a b d* (Fig. 99) be objected to, as "being in the way," although that need be no real objection to it, the base may simply be covered, at the door opening and a few inches beyond it on either side, with a smooth metal, as shown at *g g*, or this need not extend to the ground, as at *h*. We have known of pillars of timber covered merely with paper, and this painted over, preventing most effectually the rats climbing up them. Anything smooth enough and hard enough to prevent their claws from entering seems to be sufficient to prevent them from climbing up a vertical surface. The hood, as *a b*, in Fig. 99, will be little more in the way than an ordinary door weather boarding, but to obviate any difficulty

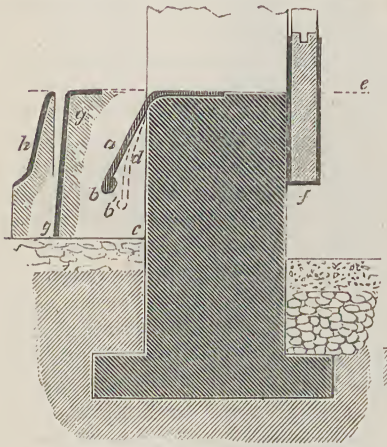


FIG. 99.

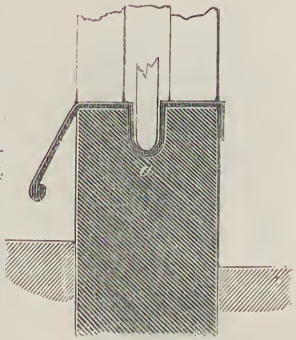


FIG. 100.

on this score it may be made with less projection, as at the dotted line *b'*. The door of the barn, if folding, in place of being cut off flush with the surface of step or sill, as at the dotted line *e*, should be carried down for some distance, as at *f*, and be finished off by having the lower or bottom rail entirely covered by sheet-iron. If, in place of folding doors rolling or sliding ones be used, the recess in the face of sill, as *a* (Fig. 100), should be pretty deep, and it will be a good plan if the hood or cap, as *a* (Fig. 99), and the recess *a*, in Fig. 100, be made of cast-iron, so as to embrace the upper part of the sill, and thus make its whole upper surface of a material impenetrable to the teeth even of rats. Where the floor surfaces of barns are made of concrete, it will greatly

facilitate their cleaning if the edges or margins at the points of junction with the walls are made rounded or curved, as at *a*, in Fig. 101. This can be most easily done by finishing off the corner with a piece of timber, the under side of which has been planed to the desired curve, as the concrete at the sharp point of junction, *b*, is apt to break or peel off if not of first-rate quality. The junction may be made as at *c*, a rough rebate being cut in the face of the wall to receive the concrete.

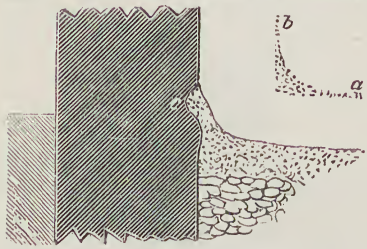


Fig. 101.

To prevent the rats, &c., as much as possible from gaining entrance by the windows, these should all be hooded, as at *d*, in Fig. 102; and no "string" or projecting course should be made outside the building in which the rats can run along as on a gangway, but the wall outside from ground to eaves should be quite flat and smooth. If this be done, the windows all hooded and the doors silled, as in Fig. 100, the rats will have some difficulty in finding their way into the building at the floor level. They may at or about the roof, the weak point of which is at the eaves, to which, both at the inside and outside level, special care should be taken to make all secure against their attacks. The other weak points of granaries are the sills, and, indeed, all the parts of window framing. Let us take these first. In the way usually adopted for fixing the frames of windows, unusual facilities are afforded for rats finding their way to the interior. Let anyone examine those frames which have been in place for any length of time, and he will find in almost every instance spaces at the sills, the sides, and at the top rail, which could be easily enlarged by rats, if, indeed, many of them have not been formed by and made use of by them. Take the method illustrated in Fig. 102, in which the sill, *a*, head, *b*, and side styles, *c c*, are completely embedded in the concrete, and it will be difficult to see how a rat could make his way past these parts and get into the building. If a projecting sill were provided, in which the rat could sit at his ease and gnaw away at the exposed wooden work of the window, the process of

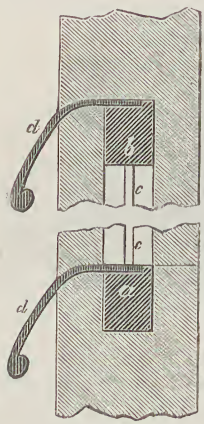


Fig. 102.

entrance might be facilitated; but with the angular or curved hoods (*d* and *d*) no resting place is afforded him to work upon, and no material upon which he can work, more especially if the window frame proper for holding the glass be made of iron or zinc, and this be imbedded in a recess or rebate in the centre of the wood frame.

The work to be done at the eaves of the roof will be of a sufficiently simple character; the same principle of imbedding as much as possible the woodwork in the interior of concrete, or hard-setting mortar—one method of doing this is shown in Fig. 103 at *a b*. The corners of the

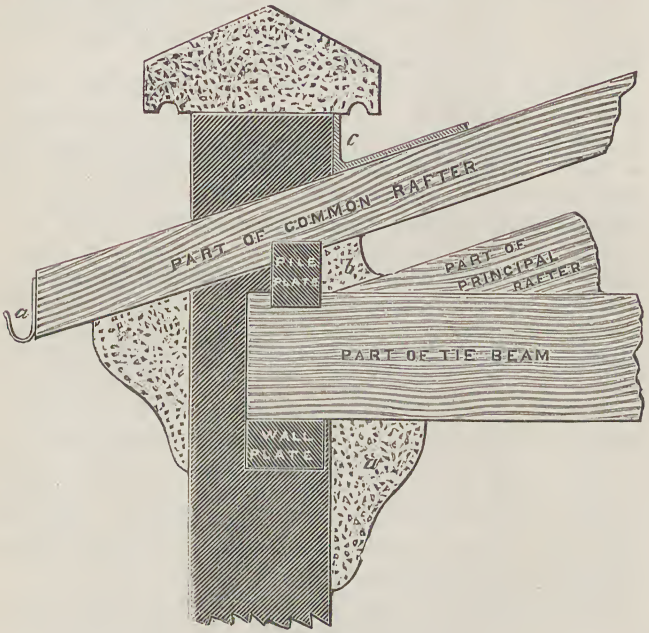


Fig. 103.

walls, from floor to ceiling of barns, granaries, and apartments in which food, &c., is kept, should be rounded off with plaster or cement, or be fitted with angular boarding, finished at top with projecting hoods, after the manner already illustrated. The vermin may run up the corners, but they cannot pass the projecting hoods. If the cement or plaster be made very hard and smooth on the surface, or the angular boards covered with zinc or with the paper, as already described, the vermin will not be able to run up the walls. The great point, however, is to have

the tops of the walls at the junction with the rafters so made as to afford no resting or running places, and this can easily be secured by using concrete cement, which can be moulded into any form or made to fill up any crevice, and soon becomes too hard for the teeth of the vermin to penetrate it. All these devices may appear trifling, but they are not so; they—or modifications of them, which will suggest themselves to the reader—will be found efficient in practice.

The apartment of the farmery coming next under our notice is the *straw barn*, about which much is not required to be said. What chiefly is to be said about it refers to its position with relation to the other apartments of the farmery, a point which will come up when we discuss the general subject of arrangement of this as a whole.

At present this part may be dismissed by stating that provision should be made to allow of a thorough circulation of air through the mass of straw contained in it. This will best be done by having means to keep up a lateral as well as a vertical circulation. The lateral circulation will be secured by giving a good number of voids, or what otherwise would be called window spaces, only that, as they are not furnished with glass filled frames they can scarcely be so called. In place of one or other of the forms of window sashes we have already illustrated, the voids alluded to above should be filled in with frames, provided with swivel or sliding shutters, to open and close as may be desired. These may be constructed to swivel on a central pivot in the centre of their length, thus opening at top and bottom, although the straw will be apt to interfere with their free action, as one end will be inwards when the shutters are opened. Sliding shutters passing into cavities in the wall (so that they can be made to slide either to the right or left) will get rid of this difficulty. These voids, or shutter-filled openings, should be placed in the side walls opposite to each other; this is required for the very purpose of keeping up the lateral circulation of air, for which they are given to the barn.

There is no floor or second storey in the straw barn as this is generally constructed, it being open from floor to ceiling, the object being to gain as much space as possible for the storage of straw, so as to have it sheltered from the weather. The floor should be specially attended to, so as to prevent damp from getting into the straw. What we have said as to the best kinds of floors for other apartments will apply to this.

The roof should be provided with ventilators to keep up a vertical circulation of air through the straw, but this will not be complete unless means be provided by which the air is admitted to the lower part of the barn, as well as openings at the top, by which

it is taken away from it. For this purpose one or other of the plans previously illustrated may be adopted.

The Manure Pit.

THE "manure pit" or "dung place" has been of a late prolific source of much talking and writing as to where it ought to be placed, and how it should be arranged and constructed that the manure, or dung, or muck should be kept in accordance with the theories or opinions of those who have discussed the "fragrant subject." Some persons prefer the old and time-honoured method of keeping the manure exposed to all weathers, and left very much, if not wholly, to itself; others prefer the newer mode of so keeping or storing it that, while freely exposed in one sense, it is not so in another, being placed in sheds open at the sides but covered at the top. After a full and fair perusal of all which has been advanced on both sides, and taking into account also the evidence of practical results in the field, we have little hesitation in saying that by far the greatest weight of practical and scientific authority rests with those who advocate the system of covered dung pits, provided with special means by which the liquid manure and the drainings from the dung itself are stored up and in close connection with it. That there is a rapidly extending belief amongst the upholders of the old system that it is essentially weak in some points, is evidenced by the fact that they do admit that their method of simply throwing the manure on the "bare soil" admits of some improvement, especially in the direction of catching and storing up the liquid drainings from the heaps. Seeing, then, this modification in the views of many of the "old school," it will render our remarks the more complete if we give one or two sketches of modifications of the open dung heap, which is far too frequently met with even in what are called, or thought to be, well managed farms.

Having the dung heap in a hole is better than having it on a higher level than the surrounding ground, inasmuch as there is a chance of the soil being of such a close adhesive nature that it is likely to retain a considerable portion of the liquid constituents of the heap, and, these remaining there, have the ultimate chance of being mixed, or partly mixed, with the solid dung when that is turned over previous to removal to the field. The next stage of improvement in the open dung heap is inclosing it with a low retaining wall, as *a a*, Fig. 104, which may be so low as that the dung may easily be thrown over it in filling or emptying the inclosure, doing

away with the necessity of having a gateway or entrance. The next improvement would be the giving of a hard floor to the inclosure, which would be as impervious as possible to liquid. And as nearly all authorities are agreed that the liquid escaping from dung is valuable, and that it should be saved, and that the best way of saving it is storing it up in a tank, either using it as liquid manure or using it to throw over the solid dung, or partly using it in these two ways, the next stage of improvement in the open dung heap would be the arranging of the floor of the inclosing walls so that it would have a slope, as *b c*, Fig. 104, which would lead the liquid either to one end of

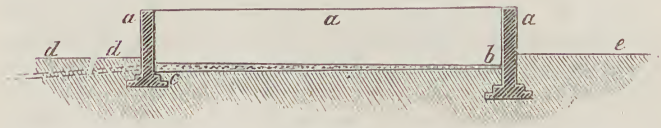


Fig. 104.

the inclosure (*a a a*), as *c*, where it would be retained, or from which it might be led by a pipe or drain tube (*d d*) to a tank—either open or closed—according as one wished to save money and have the worst, or to expend it judiciously and have the best form of manure tank. In Fig. 104, *e* shows the line of ground level.

In Fig. 105 another form of open dung heap with inclosed walls is shown in section at A, and in plan in elevation at B. In this the retaining walls (*a a*) are higher, inclosing a deeper mass of dung, with a gateway (*b*) at one side for a cart to enter; the floor (*c c*) of this slopes from the four corners, *d e f g* (B), to a central point (*h*), at which the opening to a drain tube may be placed, leading directly to a liquid manure tank as in last case.

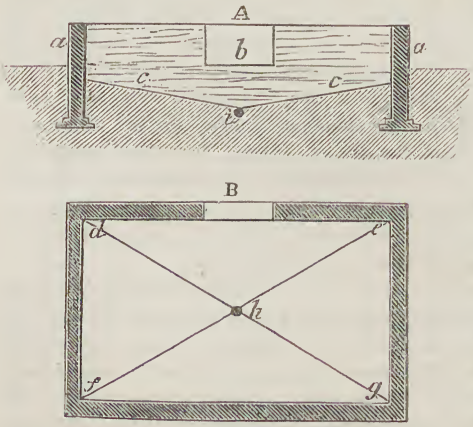


Fig. 105.

In Fig. 106 a higher stage of improvement on the open dung heap

is illustrated, in which the inclosed wall (*b*) with sloping floor (*c*) are combined with a closed liquid manure tank. In Fig. 106 the arrangement is shown in section at A (the section taken in the direction of the length of the inclosure), in plan at B, and in another section taken in the direction of the breadth of the inclosure in Fig. 107. In Fig. 106 *a a* are the inclosing walls, the wall (*a b*) to the right being continued downwards to form the outside wall of a tank, the inside wall being at *e e*, and reaching across the whole breadth of the inclosure, so that the tank is equal in length to this breadth; this inner wall (*e e*) stops short at a

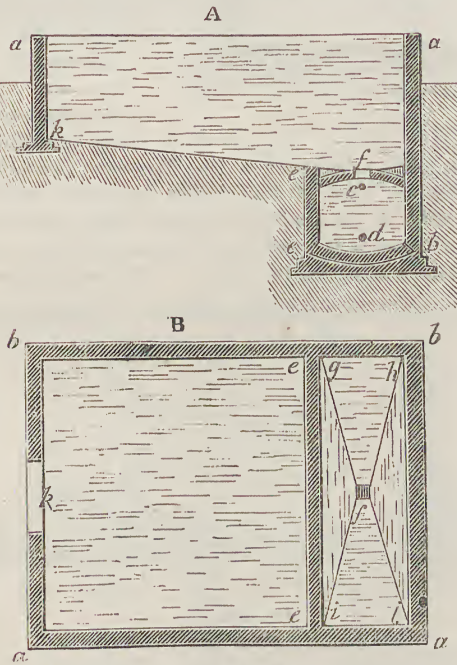


FIG. 106.

level a little below that of the floor of the inclosure, which at this point, as shown in plan at B, slopes from the four corners (*g h i j*) to the central point (*f*), at which there is a grated aperture or opening made to admit of the liquid passing to the interior of the tank (*c d*), the floor of which is formed by an inverted arch (*d*); and the roof by an arch (*f*). The other part of the floor of the inclosure slopes from *k* to *f*. The liquid may be pumped from the interior of the tank by a pipe connected with

the tank, passing through the opening (*f*), the dung being removed to admit of the grating at *f* being reached and removed, or the liquid may be led by a drain tube at *d*, or at a lower level than this, leading to a small settling tank, from which the liquid can be removed at pleasure (see a succeeding sketch—Fig. 115—for this).

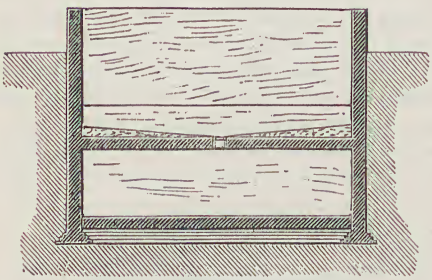


Fig. 107.

Arrangements like these now illustrated, or modifications of them, would greatly improve the open dung heap, and the last one illustrated would bring it within one stage or step of the highest grade of dung heap—namely, that which is inclosed, the inclosed space covered in, and provided with a closed or covered liquid manure tank, and a form of which we illustrate in Figs. 108, 109, and 110. Fig. 108 is a plan of this,

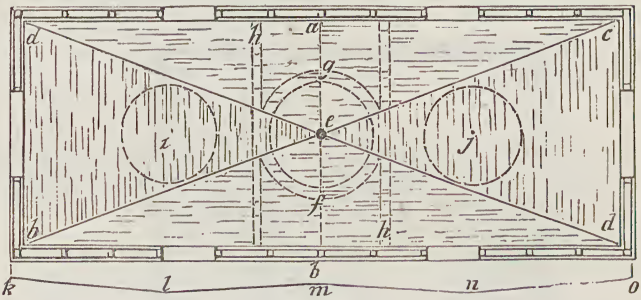


Fig. 108.

with gates at opposite points in the walls, so that the carts could drive right in without backing, deliver or receive their load, and drive out by the opposite gateway, and six gates being provided, the whole of the floor space at all points would be under command. The floor of this slopes from the four corners (*a b c d*, Fig. 108) to a central part (*e*), at which point is the liquid manure tank. The retaining or inclosing walls (*a b*, Fig. 110) are low with reference to the ground level line (*c d*), but are carried down inside, to give a considerable depth of dung as to the points *e f*. The walls carry a wall plate of timber all round, this, of

course, stopping short at the gateways; and to this uprights (*i j*) are tenoned at intervals, carrying the roof (*g h*), which may be, as in the drawing, a combination of a "collar-beam" with a "king-post" roof,

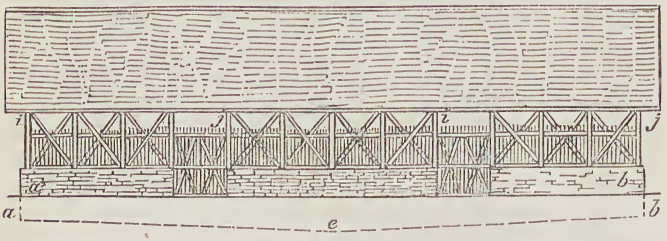


Fig. 109.

the "collar beam" as *k l*, Fig. 110 (which is a transverse section, on the line *a' b'* or *g f*, Fig. 108), being supported by the uprights *m m*, and strengthened by diagonal stays (*n n*) butting at their feet on the wall plates *o*, the small king-post, with braces or struts (*p*). Or the ordinary

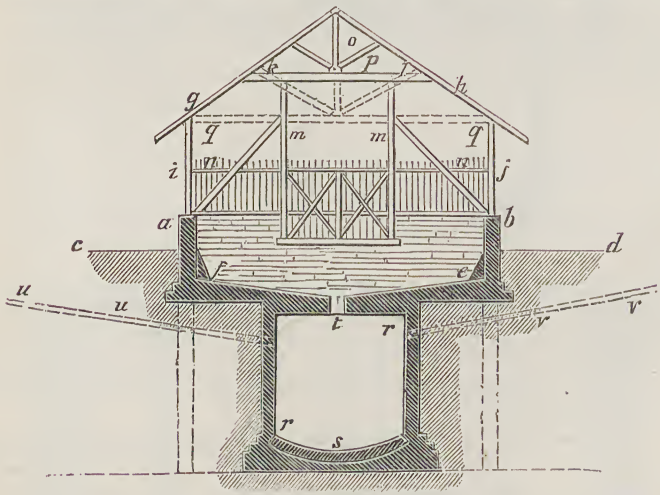


Fig. 110.

king-post roof as shown by the dotted lines may be adopted, *q q* being the tie beam, resting on the uprights *i j*, and the uprights *m m* being also used if the width of the pit is great. In this sectional drawing (Fig. 110) the liquid manure tank is at *r r*, with invert bottom *s*. The

liquid from the dung, percolating downwards and reaching the floor, is led by its sloping sides to the point to where a grated covering is placed, through the apertures of which the liquid passes to the tank. The liquid from the feeding and cattle houses, stables, &c., is led by a pipe or drain tube, as shown by the dotted lines *u u* or *v v*. Where the supply of liquid manure is large—as, where there are a number of animals kept, the liquids from the farmhouse being also led to the tank—this may, in place of occupying a portion only of the width of the pit, as shown in the plan at *f g*, Fig. 108, go right across the breadth, as indicated by the dotted lines *h h*; or two circular tanks may be constructed, as shown at the dotted circles *i j*; the central part of the floor of the pit, as *a' b'*, being raised and sloping down on both sides towards the points *i* and *j*, and the part from the ends also sloping to same point, as shown

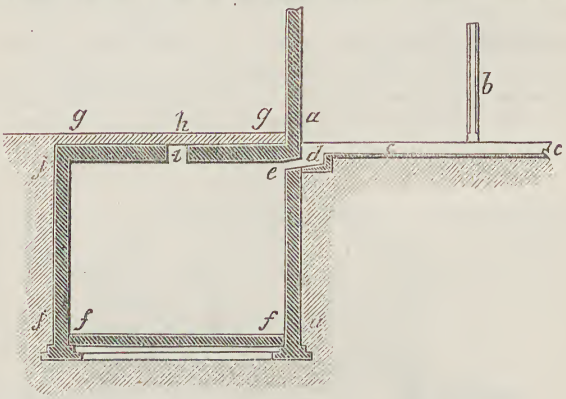


FIG. 111.

by the dotted lines *k l m n o*; *m* being the centre point of the length of floor, *l* and *n* corresponding to *i* and *j*. The expense of having two tanks will be greater than having one to hold the same quantity as the two, and a long narrow or rectangular tank will be less costly in erection than a circular one.

In some parts of the Continent, where the liquid manure is saved with a degree of carefulness to which, even in the best of our farms, there is little or no parallel in this country, the tank is often constructed at the and of the stable or cowhouse—forming, in fact, part of it, as illustrated in Fig. 111, in which *a a* is part of the end wall of stable or cowhouse, *b* one of the travis divisions, *c c* the gutter, running in front of the stalls, terminating in a grated and trapped sink (*d*), from which the liquid is led by a small pipe (*e*) to the inside of the tank (*f f*). One side of the

tank (a') is formed by continuing the wall (a a) of the stable down to the level of bottom of tank. The ground level outside the stable or cowhouse is shown at g g; and at a convenient point, as at h, an opening or manhole (i) is made—j j the outside wall of the tank.

In some cases the tank is made partly within and partly without the cowhouse or stable, as in Fig. 112, the end wall (a a) being supported by the arched roof (b b) of the tank (c c), the wall being placed above the crown of the arch. (The sketch is a longitudinal section, not showing the rise of the arch.) A manhole (d) is placed outside, and the liquid gains access to the tank by the trapped and grated aperture (e).

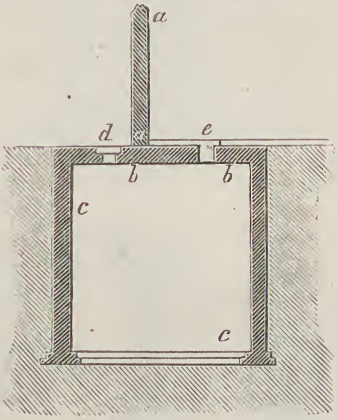


Fig. 112.

Some users of liquid manure prefer to have their tanks made with a storing-up tank and a mixing tank combined, the latter being used for the purpose of mixing the liquid exuviæ as they come from the animals, with artificial manure, according to the crop to which the mixed tank liquid is to be applied. When the mixing principle is judiciously carried out very beneficial results are obtained from it.

Fig. 113 illustrates an arrangement of a combined tank or tanks. If water is to be added, as in the majority of cases it will, the mixing tanks

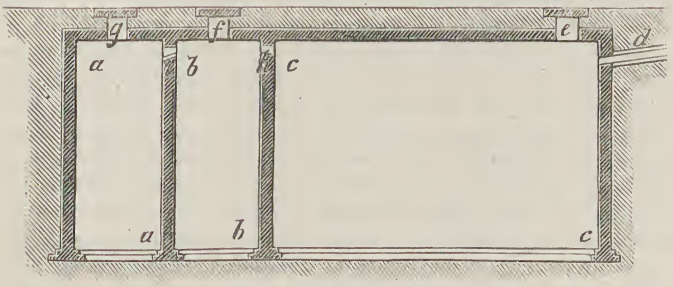


Fig. 113.

are preferred by some to have double the capacity of the regular tank. In the arrangement in Fig. 113 there are two mixing tanks (a and b) of

equal capacity, but of much less capacity than the tank (*c c*) in which the liquid exuviæ, &c., of the farm stock, &c., is collected. In the figure *d* shows the pipe conveying the liquid to the main tank (*c c*); from this the overflow passes by the tube (*h*) to the first mixing tank (*b b*), and from this the overflow passes by the pipe or tube (*i*) to the second mixing tank (*a a*). A manhole, as *e*, *f*, and *g*, is provided to each tank. In the case of tanks built separately from the solid dung stand or pit, a drain tube should be laid down to lead the liquid flowing from the dung to the interior of the liquid manure tanks.

In the construction of tanks the greatest care should be taken to have the walls perfectly water-tight. It is not sufficient to trust to have this secured by good building of the wall, and the joints, if not laid, at least pointed with hydraulic cement; but it will be better to have the outside of the walls well puddled with clay, as shown in Fig. 114, where *a a* is part of the wall in vertical section, *a′ a′* in horizontal ditto, *b b* the puddled clay, at least a foot thick, *c c* the soil, *d* the side of tank wall near the interior. One word as to the puddling. The clay used should be of the closest, most adhesive kind obtainable, and it should be thoroughly worked and incorporated, and all extraneous matters, as stone, soil, vegetable, and all matter capable of decomposition taken out of it. The layers should be very thin, in no case exceeding twelve, but better if only nine inches thick, and the whole should be well beaten or rammed down, this beating extending over the whole surface, not merely being given at a point here and a point there. Simple a thing as puddling is, it is an operation demanding great care.

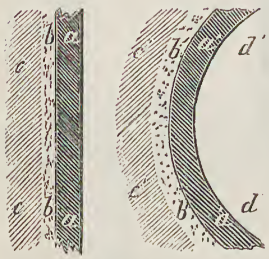


Fig. 114.

Some prefer the solid parts, which are mixed in greater or less proportion with all the liquid exuviæ passing from dung pits or farm stock houses, to be passed into the collecting tank, and to be mixed with the liquid by being stirred well up from time to time; others, again, prefer the solid parts to be kept out of the tank, and then to be filled with liquid as clear as possible. When the liquid is distributed by liquid manure carts, with perforated pipes, this is the better plan, and apart from the advantage of having for these carts clear liquid, the solid parts accumulate at the bottom of the tank, and are difficult to be removed therefrom. "Settling tanks" of small dimensions are therefore now in some cases attached to liquid manure tanks, into which the liquid from the dung stand or stock houses is first conveyed; in these the

liquid remains till the solid parts settle at the bottom; the overflow then passes from the small settling tank to the large tank by a drain tube. Fig. 115 shows this arrangement, in which *a* is the tube convey-

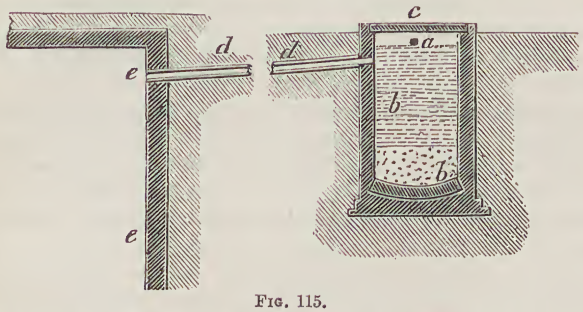


Fig. 115.

ing the liquid to the small settling tank (*b b*), covered by a stone cap (*c d*), the overflow pipe leading to the large tank (*e e*.)

It is not an easy matter to decide as to the capacity or cubical contents of dung pits and liquid manure tanks, as so many circumstances come into operation modifying the results of calculation, such as the length of time the contents are to remain and the difficulty to estimate the quantity—especially in the case of general tanks—of the substances delivered to them, as rain, house refuse, &c., which are very fluctuating quantities to deal with in calculations, as, indeed, are also the products of the animals themselves. As regards dung pits, the estimates of the weight obtained per day per head of stock vary from half to a whole hundredweight, or, say, from fifty to one hundred pounds. The weight of a cubic yard —*i.e.*, a heap measuring a yard every way—depends of course upon the condition and density of the manure, varying from 15cwt. to 20cwt.; but taking a ton to be the weight of a cubic yard, which again varies with the age, &c., of the manure, it will take thirty stock, each of which we suppose to yield the mean of the two weights named above—50lb. and 100lb.—to make a cubic yard per day. From this, and from the period during which the dung will occupy the pit, some approximate estimate may be made of the dimensions of the pits required. As regards the liquid manure tank, the household liquid may be put down at twenty-five to thirty gallons per head per day, the exuviæ of a cow per annum at a thousand gallons, a horse four hundred, and a pig one hundred.

Implement Shed, Workshop, and Smithy.

Taking up the class of apartments which, although not considered actually necessary, are often added to farmeries as great conveniences, we would first notice the implement shed, the general workshop, and the smithy.

If an implement shed is proposed to be erected, then care should be taken in planning it as regards "place," and the best place for it is next the workshop and smithy, for these apartments should also form part of the general design. Now, as the position of the implement shed is thus dictated by that of the smithy and the workshop, as repairs can be thus done when required in the most direct and ready way, the point is, where should the smithy be? Obviously, as far away as possible from the straw barn, food stores, and feeding houses. Some advocate the complete isolation of the smithy from the rest of the building; others in their desire to have all the buildings as compact as possible, and the apartments which have a relation to each other placed together so that no time be lost in going unnecessarily from place to place, make the smithy, the workshop, and the implement shed part of the general design, but at an extreme side or corner furthest from the places we have named above.

Where the steading is in the form of a parallelogram or a three-sided rectangle, the open side being to the south-east and the yards and feeding houses facing or opening to this which gives the best aspect for them, a very good arrangement is to have the east end of the rectangle occupied by the cart shed next to the stable, the implement shed, the workshop, and the smithy, the last being at the end of the range, as shown in Fig. 116, in which *a* is part of the stable, entering either from the end, *á*, if having double ranged stalls with central passage between them, or by the north side at *b*, if single range stalled, *c* being the side towards the open rectangle. Coming down the east side of the buildings, the first place nearest the stable is the cart shed, *d*; next to that is the implement shed, *e*; then comes the general workshop, *f*, and last of all the smithy, *g*. On the return corner, a small lock-up store, as *h*, for small tools and implements, as scythes, sickles, &c., may be placed. This will be found as good an arrangement as can be made where all those apartments form an integral part of the general steading; it need scarcely be said that the cart shed, *d*, always does.

The cart shed is carefully floored, generally with the round pebble pavement, but we prefer concrete. The shed is generally divided into "bays," by having stone pillars in front, on which the tie beam of the

roof rests. The distance between the pillars is the usual cart or waggon breadth, with six or eight inches of clearance on each side. The corners of the pillars should be "chamfered," or, if greater neatness is desired, "stop chamfered," and a base and cap provided.

There is no necessity to divide the implement shed into bays, but, to preserve uniformity of appearance, it may be so divided. The back of the implement shed should be provided with racks and one row of shelving; these will be found very useful.

The general workshop will be fitted up with carpenter's bench and the usual tools provided, for which racks, shelves, and drawers should be given with liberal hand, for one should like to see order in every department. An exceedingly useful addition to the tools of the "shop" will be a mortising and tenoning machine, or one of those capital machines known now as the "general joiner," by which almost every kind of work in wood can be done, will be still better. A turning lathe and a small circular saw bench will be found very useful, and these might be worked by a flywheel, pulley, and belt.

If the estate be large, and has several farms on it, and where much home-grown timber is used for farm purposes, the workshop will require to be larger and fitted up with a wider range of tools and machines; of the latter a powerful circular saw will be the most important, as steam

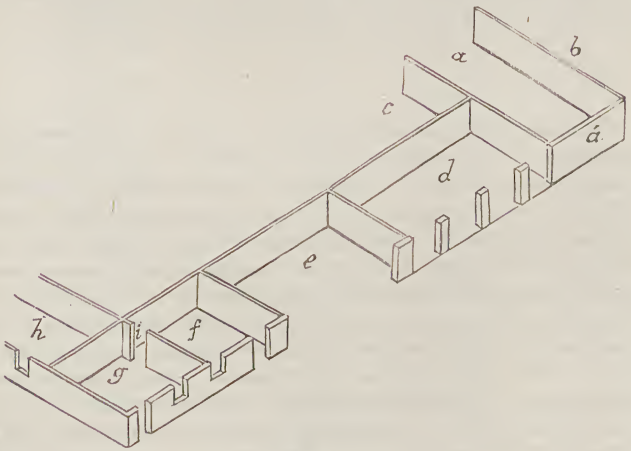


Fig. 116.

power will be required to work this and the other machines. The best place for the general workshop would by some be thought to be near the

engine room and thrashing barn; but even in this case perhaps the best position would be as we have indicated in Fig. 116, a small steam engine and boiler being fitted up, or, if portable, placed in the smith's shop, from which power could be taken to work the wood-cutting machines, &c., in the carpenter's shop. Although this at first sight would appear to be an arrangement less economical than that of placing the workshop near the stationary engine and thrashing machine, it would not in reality be so, for the large steam engine would have more power than would be required for the workshop machines, so that to raise steam in its boiler would be more expensive and take longer time than the putting in work of a small portable engine, which would, of course, be proportioned to the work it had to do.

Returning to the illustration in Fig. 116, we note that in some cases a door of communication, as indicated at *i*, is made between the smith's shop and the general or carpenter's workshop. This we do not approve of, seeing the danger there is of fire from the wood shavings, &c., generally so abundant, and too freely kicked about in carpenters' shops. Indeed, for this reason we should prefer to place the carpenter's shop behind the implement shed and the smithy at the west corner of the farmery, corresponding to *g*. Were it not for the fact that, as a good deal of work of the farm is done in common between the carpenter's shop and the smithy, time would be lost in going to and fro between them; hence the reason why we place them together, as in Fig. 116.

We now come to the consideration of the last department of the structures of the farm, namely, those which may be classified as coming under the name or title of "isolated buildings of the farm." When we come to discuss the subject of arrangement of the various structures we have described and illustrated, as a united whole, under the general name of farmery, or farm steading, or by whatever name it may be designated, we shall find that, although, as a rule the various isolated structures we have described are brought together so as to form one group, still there are those who advocate another method of arrangement. This method may for the present be simply described as the breaking up of the usual single group of buildings constituting the farm steading into a series of single groups, more or less numerous; and this according to the size of the farm, which, if large, may demand a cattle house here, and another there, and so on. Now, this system obviously demands a style of building or construction for "outlying buildings" of the farm of a more permanent, if not more ambitious, character in point

of arrangement and design than those which have for their object the mere sheltering of a few cattle or of sheep in an isolated part of the farm. In point of fact, it, in one sense, may be said to be but a mere repetition of the plans of structures we have already illustrated and described, set down at the different points of the farm considered necessary.

These isolated buildings naturally divide themselves into two classes, the first being those of the simplest possible character, suitable merely as shelter sheds at isolated parts of the farm, the second coming under the system to which we have but now briefly alluded, in which the building accommodation is divided into groups.

Shelter Sheds.

We have, therefore, only to take up the consideration of the simplest structure. We think it is abundantly obvious that, in every sense, it would pay to have "shelter sheds" erected in the out fields of the farm where cattle are wintered, if "wintering" as a system will be persevered in as part of farming, for it is not merely as sheds or structures affording shelter to the animals against the rigours of the climate that such structures will be useful, but also for providing food stores, in which supplies of forage, roots, &c., medicine for emergencies, &c., can be stored, and as shelter to stock in summer against the hot and fierce rays of the sun, attacks of the fly, &c. By no means a comfortless shelter for a few young stock may be obtained in positions where there happens to be a high natural bank. Where this is in a field, the face of the bank, if too sloping in character, may be cut so as to be more perpendicular, or scarped or benched out, care being taken to have a drain or trench at the foot. This may be a simple open trench or cutting, covered over with stones, tiles, or timber. To make the place as "cosy" as possible, the face of the bank may have stakes driven in at intervals between each of nine inches or so. These should be driven in at an angle oblique to the line of ground. The stakes should be in parallel lines, and straw ropes, pretty strong, should be twisted round these and led from one to another in vertical as well as horizontal lines, forming thus a species of network of straw rope. Tarred rope will last longer, although, of course, a little dearer, or galvanised iron wire may be used as better still. Behind the network thus formed a clever stacker will soon intertwine straw, which will form a very comfortable lining to the otherwise damp wall of the bank of earth. Care should be taken to leave a space behind the face of the bank and the straw, so as to keep off the damp from the straw as much as possible.

So much for the back wall. The front wall may be simply and quickly formed by driving in vertical posts, and the one end in the same way; or the two ends may be both made up and the front partly so, leaving an open door in the centre, as is usual in sheds. Between the stronger vertical stakes lighter ones should be driven, and between the whole the rope network and wattled straw must be worked in. The roof will be formed by timbers, stretching from the front stakes on a wall plate on top of these to the bank face, into which they must be fixed. The roof must be thatched or partly thatched, and covered with tarpaulin or waterproof felt (which is very cheap). By this means a very comfortable and certainly by no means a dear shelter shed may be erected. The whole of the timbers used may be "home" timber, and a clever, handy fellow on the farm will be able to use up a lot of odds and ends which are sure to be found lying about the farm buildings, and which usually are looked upon and treated as worthless lumber, in a way which may astonish his master. In like manner, a small closet or store may be knocked up at one end of this shed. By looking after this simple structure, patching up a rent here, and fastening up a loose place there, it may be made to last for a very much longer time than one would be apt to suppose. By taking advantage of the corner where two walls of a field meet, the shed may be still more economically constructed, as two of the inclosing walls may be thus obtained without cost. If the walls be too low they may be raised, or vertical timbers driven in against them at intervals of sufficient height; roping and straw wattling the spaces between them, as we have already described.

These are mere hints, but they will to a "ready-witted fellow"—of which every farm generally has one or more—serve as practically useful, in enabling him to "knock up" very quickly and sharply sheds which will be of great service.

Where on some farms what are called cobble or pebble stones—that is, pretty large and rounded stones—are to be had in abundance, isolated buildings, such as shelter sheds, can be built with them very expeditiously. It is not claimed for buildings of this sort that they are much if any cheaper than those constructed in the usual way; but there is this feature connected with them, that they can be built without the aid of skilled labour—any ordinary farm labouring man being quite able to undertake the work, while the materials are on the spot. All that is essential is good, indeed, first class mortar, which is used for the binding or bonding material. If the stones are pretty large in size, and there be a man on the farm who has been accustomed to do "dry-stone walling," the wall should be built up just as a dry-stone wall is constructed, and the mortar in a pretty thick condition pressed into and between the inter-

stices, the trowel being used to take off all the mortar which protrudes from the outside and inside surfaces.

Should the stones be small, a rough kind of wooden mould would be essential, this being filled with the stones, in any fashion thrown in, and the mortar "grouted" in, as the technical phrase is—that is, used so thin that it can be poured in and run between the stones. The best size for the stones is that which will give a weight of 2lb. The feature of this kind of building, which is admirably adapted for many of the structures of the farm, which can be run up at any convenient time, is rather that the stones form the nuclei, so to say, round which the mortar hardens, than that they form the basis of the building. In fact, it is more of a mortar wall than a stone wall; hence the mortar must be good, the lime constituting, say, a third part, the rest the sand. This should be free from all earthy stuff—in fact, be pure sand; and it does not matter how coarse this may be. This kind of building is best carried up in dry weather—not frosty; and about 2ft. vertical a day should be the maximum height set up, to allow of the proper settlement and the hardening of the mortar. Large barns have been built upon this plan, and promise to stand for many years to come. Some flint stone buildings of this kind are known to be fifties of years old.

For the isolated and what may be called the odd buildings of the farm, there are thus many modes of construction open to the intelligent farmer. We may here say that we have often been surprised that the "pise," or hard rammed earth plan of building, has not been more largely adopted than it has been. In many places abroad it is carried out very cleverly and efficiently for the construction of dwelling houses, and vastly more healthy and comfortable they are than are many of the wretched tumble-down brick-and-stone cottages in which so many of our farm labourers are compelled to live. We do not advocate the use of this kind of building for human dwellings; but a modification of it might be used with economy for isolated buildings such as we have now considered.

PART III.—THE DAIRY.

General Remarks.

The next apartment, or rather series of apartments, we have to consider are those of the dairy. It is not every farmery which has or requires such; in mixed husbandry farms, in districts where there is no demand for the milk or butter, or where the distance from a town or railway makes the sale of those articles unlikely to pay, the farmer keeps simply a cow or two for his own use, and in some instances he provides accommodation for the cows of his labourers. In such cases the dairy accommodation for storing up the milk and making up the butter, &c., required is very small, and it is generally made—from motives of economy of time and labour—to form part of the farmhouse. Dairy room arrangements in cases like this will be treated hereafter. In some farms not strictly dairy farms—as those situated near a town, milk and butter being in great demand, and high prices being obtained for them—the dairy accommodation generally forms part of the range of farm buildings, or, if isolated therefrom, is placed near them, so that the milk from the cow-house can be easily carried to the milk room. In dairy farms it is unnecessary to say that the dairy accommodation forms a very essential and important part of the farmery. The whole subject is one which would well admit of a special treatise or volume being devoted to it, but we hope to give a fair *résumé* of its leading features.

A good deal has been written upon the relative merits of the two systems of providing dairy accommodation; that in which it is given as part of the general range of farm buildings or in an isolated building, and much can be and has been said on both sides of the question. Milk being peculiarly liable to be acted upon by taints and smells of all kinds, which quickly render it useless, and also being difficult to keep in hot weather, the isolated system offers many advantages; it enables the milk house to be kept far from the cowhouses, stables, &c., where bad smells arise, and from the barn, &c., in which much dust and dirt prevail; and further, being independent of all other buildings, the dairy rooms can be built so as to have the best aspect, and in such a way as to

become, to a large extent, the best way of keeping the milk. But, on the other side, the plan of forming the dairy as part of the general farm buildings affords the greatest facilities for working, not only for taking the milk at once to the milk room from the cowhouse, but in placing it so that, in large dairy farms, the power can be had to work the churn. The farmer, knowing best his own circumstances, will best be able to decide between the competing claims of the two systems.

The Incorporated Building System.

TAKING up the system first in which the dairy is incorporated with the general buildings of the farmery, we give, in Fig. 117, a suggestive plan,

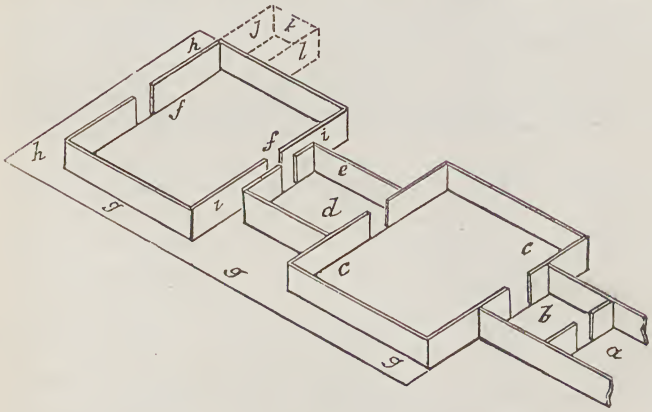


FIG. 117.

showing arrangements which, of course, can be modified according to circumstances. The dairy apartments must be placed on the north side of the farm buildings, so that none of the milk house windows shall have a southern aspect, and the south wall of this apartment should be built with a cavity or hollow well, so as to keep it as sheltered from the direct rays of the sun as possible ; and further, to secure this, a deep shaded verandah should be placed on this side. Because of the readiness with which milk taints, as mentioned above, it is the wiser plan to avoid all risks, and to place the milkhouse as distant as is consistent with the saving of labour in the carrying or transportation of the milk from the

cowhouse. The advantages of this distant position, without its actual realisation, may be gained in some measure by making the door of communication between the two double, or by placing a store room in which the cleaned and therefore sweet and taintless vessels and appliances useful in a dairy may be kept, and through which the milk must be taken from the cowhouse to the milk room. This arrangement is shown in Fig. 117, in which *a* is part of the cowhouse, *b* the store room, *c c* the milk house, *d* the churning and cheese making room, in which there are stairs, at side *e* to give access to the cheese store in the second floor above, at end of granary. The washing and boiler room (*f f*) is separated by a passage (*i i*), this passage being given so as to keep all smells from gaining entrance to the milk room. A verandah (*g g g*) keeps off the sun's rays from the milk room, while another verandah (*h h*) is placed at the end of wash house, under which the milk vessels, churns, &c., which have been washed, are placed to dry.

This arrangement, adapted to form part of the general range of the farm buildings, can be modified at will, and is obviously adapted only to farms where dairying forms one, and not a large part, of the ordinary work of the farm. When it is deemed advisable to have those dairy buildings isolated, an arrangement such as in Fig. 118

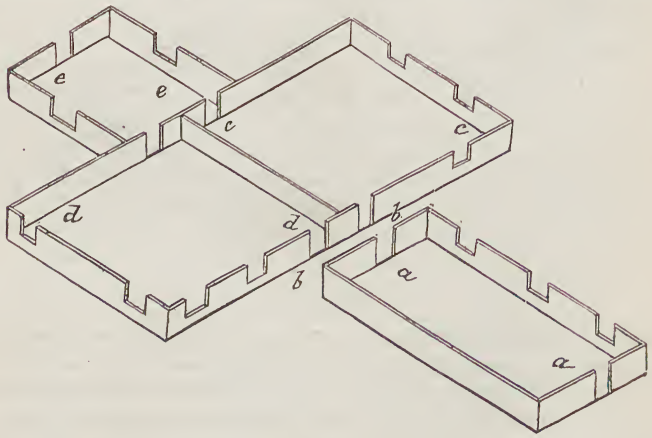


Fig. 118.

may be adopted, *a a* being the milk house, separated by a covered passage (*b b*) from the churning room and cheese-making room, *c c*, *d* the cheese store, *e* the wash house, the whole being surrounded by a verandah. Of course it would be easy to give a variety of suggestive

plans, showing different methods of arrangement, for plans are endless in their combinations; but those we have given may be taken as representative ones, and they show what is required by way of accommodation suited to ordinary circumstances. In large dairy farms—where dairying is the chief, if not the only, work to be carried on—the accommodation, although essentially the same as here given, has some additional features.

We now come to the consideration of the constructive details of the dairy apartments, and, first, as to the milk room. This must be so constructed that it be absolutely dry, light, and well ventilated. Taking these three essentials in the order named—dryness, or freedom from damp, how is this to be attained? The dampness, which arises from, or is the result of humidity in the air, and which varies according to climate, cannot be got rid of, but it may be and is greatly modified and lessened in its prejudicial effects by contrivances hereafter to be named. That which arises from locality often arises from the bad choice made of that locality—as, for example, where the farm buildings are placed near a river, near a lake, marshy land, or in a low-lying and generally undrained position, especially where the north side is towards the dampest part—we can then only make the best of the circumstances, and this best need not be hoped for to be anything like very good.

A great deal of the dryness of dairy buildings will depend upon the soil of the site, and, if that happens to be clayey, especially of a close, adhesive, and therefore retentive, character, little hope need be entertained of having any approach to perfection of dryness in the milk room. Much, however, may be done, even with such unfavourable material, by thoroughly draining the site for some distance all round the building, by excavating the soil for some depth under the floor and for some distance beyond the walls, filling up the excavation with dry and good smithy clinkers, or coke, or good cinders, and finishing all with a layer of good sound and well-laid Portland cement concrete. In laying this, one point should not fail to be attended to, namely, carrying it beyond the walls for some distance, say, at least twelve or fourteen inches.

The floor of the milk room, if also formed of concrete, will be a good one; but, as the colour is not very agreeable to the eye, and it is not very smooth on the surface, it may be finished with tiles, either glazed or otherwise, or it may be boarded, these being laid while the cement is soft. Boarded floors are apt to retain the damp, and, as it is essential that the milk room should be kept in a condition of absolute cleanliness, and as that cannot be attained and kept up without the use of water, a floor surface which will dry the quickest is the best. The roughness and colour of Portland cement floors may be improved by rubbing the surface with pumice stone, or by carefully smoothing it

with the trowel before absolutely hardened, and it may be colour washed, before it is quite set, with a white or French blue, or yellowish wash, or the last layer of the cement may be mixed with those colours in their solid state, or the water used to form the cement may be a colour wash.

The walls of the milk room ought in all cases to be built hollow, or made cavity walls as they are otherwise termed. Although counter to the opinion of many, the driest and best building material is good sound stock brick, well and carefully pointed with cement on the outside. Stone may appear to give a more solid wall, but the great majority of stones used for building are more absorbent of damp than stock brick, sound, hard, and well burnt. And, what is worse, stone retains the damp much longer than brick; indeed, when it gets thoroughly saturated with damp there is scarcely getting it dry again. Further, bricks, from their unvarying size and form, admit of a solid wall being built; while stone, being of all sizes and forms, admits of "scamping work," and gives great temptations to the workmen to build what may be called "honeycomb" walls, anything but sound and solid in their interior, however solid they may appear to be externally.

The interior surfaces of the walls of the milk room should be most carefully finished. Finishing off a building with timber battens, upon which the plaster is laid, will add greatly to the dryness of the walls; and it will help greatly to the keeping of the interior clean and sweet if the walls be laid up to a point at least 2ft. above the level of the milk shelves with pure white or cream-coloured Staffordshire encaustic tiles, set in cement. The windows should be in all cases double, the inner one glazed, and the outer frame may be fitted with perforated zinc. But the better plan would be to have both inner and outer window frames glazed; the leaves of the outer window hung casement or "French window" fashion, that is, opening in two leaves or halves vertically, and shielded with an external frame fitted with finely perforated wire gauze or zinc. The inner glazed frames should be hung in the manner we have already illustrated, the upper leaf to swivel, so that the entering fresh air can be thrown either up to or down from the ceiling, while the under leaves, being hung casement wise, the air can be thrown either right or left as desired. At the same time the wire gauze fitted frame should not be omitted, being outside of all; it will be useful in hot summer weather in keeping out flies, &c. The doors should be made double, and both be provided with the patent vulcanised indiarubber dust and draught proof stop.

The roof should be made double, that is, with a space of six or eight inches in width or depth between what may be called the inner and outer

skins. The outer roof should be covered with boarding and felt, and, above and over all, the Staffordshire roofing tile, which will be better than the ordinary thin slate. There is a capital form of tile made with hollow perforations, through which currents of air keep flowing, tending to equalise the temperature very much. A clever "slater" might by the use of ordinary slates form an excellent double skinned roof, of great value in dairy building work. The inside roof or inner skin in which the ceiling is formed should not be flat, but curved or pavilion, what is often termed a coach house roof, that is, with a flat part in the centre of considerably less surface than the floor surface; and the walls at sides and ends joining this with an easy curve of considerable radius. The corners running up from the floor to join the corners of these curves should be rounded off, the great object being to prevent the formation of any parts in which or on which dust and cobwebs can lodge and remain; to aid in this all moulded cornices and "gingerbread work" in plaster, &c., of any kind should be rigidly excluded from the interiors of milk rooms.

The object of all these structural arrangements and details now briefly hinted at is to keep the milk room free from damp, and also at a temperature as uniform as possible at all seasons of the year, this ranging from 62° to 65° or 66° Fahr., and, further, sweet and clean and free from dust—in itself, by the way, a prolific source of "taint" to milk. We have indicated the best methods of securing those ends, leaving, of course, the proprietor to modify them as his taste, notions, or purse may dictate.

Other arrangements in the best arranged and constructed milk rooms are also required, as ventilating appliances in the roof, to create, maintain, and regulate thorough currents of air through the interior of the apartment. These we have described in principle and detail in preceding chapters, and modifications of them to meet certain peculiarities in the milk room will be obvious on a slight study of them.

In the very cold weather means should be provided to raise the temperature of the milk room, and in very warm weather to lower it. Of course these are not essential, though they are very desirable. For heating or raising the temperature of the milk room, the best method is the hot-water pipe system, the pipes running round the room at or near the level of the floor, in front of openings made in the wall, by which fresh air is admitted, these openings being regulated, as regards the amount of fresh air admitted through them, by valves worked in the same way as hot or green house valves used for the same purpose. Another method is open to use, and has been recommended by some; this consists of an open trough placed below the milk shelves, these troughs being inclined

from one end to the other; and along which a stream of hot water is allowed to flow. We do not approve of this plan, on account of the vapour or steam which will be sure to rise, and cause dampness in the air. To obviate some of the evils of this system, it has been proposed to modify it by placing the milk vessels themselves in the open trough filled with water of that degree of heat as to keep the milk at the desired temperature; but even this plan we do not think so good as the hot-water pipe system, which keeps the air of the milk room uniformly and generally warm throughout its whole interior, without in any way causing the air to be damp—on the contrary, keeping it dry, but which may be rendered slightly damp, if necessary, by any of the methods now so well known. To cool the air in hot weather or to keep the milk vessels of the proper temperature, the open trough system is a good one, a stream of cold water passing continually along the troughs. A better and more modern plan, however, is having ice shelves or boxes placed in the best positions; these keep down the temperature effectually and at a cost by no means great. But if the milk room be arranged and constructed as we have explained, and the ventilating system, windows and roof ventilation, &c., be carried out, a wonderfully uniform temperature, and nearly approaching the right degree, if not actually attaining it, will be secured throughout a large portion of even pretty warm summers, with the occasional and moderate use of ice.

In view of the importance of keeping the temperature of the milk room as uniform as possible throughout the year, the plan often adopted in North America has been proposed to be, and is in some instances, carried out in this country, of having cellar milk rooms. Although the difficulties are considerable in the way of rendering underground rooms perfectly dry, still they are not by any means insuperable; and there is no doubt of this, that a uniformity of temperature is more easily maintained in such apartments than those built above ground in the usual way. But other inconveniences arise from this plan; to name only one here, the having to descend and ascend the steps by which the room is reached involves no small loss of time and expenditure of labour taking the year round. So that, upon the whole, the plan of having the milk room on a level with the other dairy apartments will be the best.

The milk shelves are made of various materials, and are fitted up in various ways. If wood be used, sycamore, or plane as it is otherwise named, is the best kind to employ, as this is very close grained, it does not easily absorb damp, and is easily cleaned. Iron grated shelves are perhaps the best; they are cool, easily kept clean, and the gratings admit of the free current of air up and past the milk vessels. One word of advice as to the fitting up of the shelves, and the value of which

will be seen at once; the shelves which are ranged along the walls should be kept forward a little, so as to be clear of the walls some inch or so; this not only admits the air to pass freely up the back of the shelves, but also of the corners being thoroughly well cleaned out.

We now come to the washhouse, about which little need be said further than this, that although it is the one place of a dairy in which dirty work is to be done, it ought nevertheless to be kept clean itself, and in every detail well ordered. The fittings comprise a boiler or copper, by which a supply of boiling water can at all times be had, washing tubs, either fixed or movable—movable being by far the best, for obvious reasons—and amply supplied with water, and shelves on which to place the cleansed vessels. It is needless to say that the ventilation of the washhouse should be as perfect as possible, so that no vapour be allowed to remain for a second in its interior, but be carried off at once. In addition to other contrivances and appliances, advantage should be taken of the boiler chimney to withdraw the vapour, &c. The floor must be impervious to wet, and so laid that the water will not stagnate at any point, but be drawn off with the most certain rapidity. To insure those two essentials, no material will give such good results or be so economical as the concrete floor. The outside of the washhouse should be provided with a broad flagged tile or concrete covered walk or space all round, and this sloping from the wall to a drain in the outer edge. This will afford space for vessels to be placed in order to get drained and dried, and in fine weather for carrying on many of the washing operations. This walk or space should be verandah covered, the outside supporting pillars of the verandah being provided at intervals with hooks to which vessels, &c., may be hung up on occasion to dry and have good sweet fresh air blow about and through them.

Between the milk and the washing room the churning and cheese rooms are placed, being separated by double doors from the two. The churning room should be provided with a marble or slate slab, hollowed slightly out, on which the butter is to be made up, and having near it a tap to supply pure cold water, another for warm coming direct from the boiler, to be used for cleaning purposes, and a trapped and plugged or valved waste pipe, to lead off waste water.

The Isolated Building System.

We now come to the consideration of dairies on the large scale adapted for what are called dairy farms, in which dairying is the only

work done, all the other work, of cropping, &c., being subservient to this.

Dairy buildings on the large scale will obviously, so far as general features go, resemble closely those on the small scale, inasmuch as the same operations or processes are to be carried on and worked out in principle; although the details may be, and are different, the difference lying chiefly in the fact that modifications have to be introduced on account of the greater bulk of materials to be dealt with; and the fact that different processes may be carried on in the same building; as, for example, the making of butter from the whole milk, and also from the cream together as already alluded to, with such alteration in details of the working, and also as to whether the "factory"—as large dairy buildings are now called—is to be devoted to the making of butter or of cheese alone, or partially of both.

When we come to consider the general arrangement of farm buildings in which the different apartments—which as yet we have considered as isolated structures—are placed together upon certain principles of arrangement, so as to form a connected whole; we shall then show the relation between the cowhouse and the dairy buildings proper. Meanwhile we have to take up the details of those as arranged to carry on business on the large scale, taking up first butter-making arrangements. The first thing to be decided upon, is whether butter is to be made by churning the whole milk, or by churning the cream; and, secondly, whether the milk if used, or the cream if used, are to be churned in their natural or sweet condition, or whether they are to be kept till they are "soured," "cauved," or "lappered," as the different phrases go, and then churned. It is necessary to decide these points, inasmuch as the decision involves important considerations as to the kind and extent of accommodation in the buildings, as also as to the appliances and machinery required to work the dairy.

Perhaps as affording the most practical representative plan for a large dairy, it may be the best way to give one in which the butter is made in both ways—from the whole milk, and from the cream, but both being previously soured. The two principal points to be first secured is, first the aspect, and second the relation of the milk-room to the cowhouse. The aspect must be such that the whole of the windows and doors of all the apartments in which the milk is stored up and dealt with, must be to the north; and the position of the site such that, while securing this, it will facilitate the transit of the milk from the cow house to the milk house, this being best secured by the site of the latter being lower than that of the former. In this way the tram-rail will have its inclination towards the milk-house, so that the full milk-cans will run down the

incline themselves, brake power being put on to regulate the speed as necessity requires. The bringing up of the milk cans to the cow house will be an easy matter as they will be all empty. A further advantage obtained from this lower level of the milk with relation to the cowhouse will be that the cold water which may be used to cool the milk in the milk house, being admitted under the milk vats at the higher will flow naturally to the lower level, and thence be led with its temperature somewhat raised to the boiler in the milk house; this again being so placed with relation to the vats in the cheesemaking rooms, that these will be at a lower level, so that the hot water will flow naturally from the boiler into them. The "levels," or rather the inclines, with relation to the general line of level, will thus all be made with one common object in view—the saving of manual labour; and it is obvious that the "drainage system" for the removal of the used water will also be facilitated greatly by the same plan of laying down the buildings. And although in a lesser degree, the sanitary objects, so to call them, will also be assisted, inasmuch as the cowhouse, standing at the highest level or point, the smells from it will be carried more quickly off, and be less liable to taint the milk in the milk house than if this was at a lower level.

The two points, then, of aspect and general position of the dairy rooms, and their relation to the cow house, being thus secured, we have next to consider the way in which the various apartments of the dairy should be best arranged to secure an effective whole. In one respect the plan of having all the apartments beginning with the milk and ending with the wash room, would be the best, as every operation would then follow in its natural course—each apartment being immediately connected with and contiguous to the one in which the preceding and succeeding processes were carried on; and constructively it would be the cheapest, as the roof—which is the most expensive part of all structures—could be carried on in one unbroken line without any breaks or angles. But this arrangement of the apartments "all in a row," would not be the most compact. This alone, however, should not act prejudicially against its adoption; for there are other points which stand in favour of these arrangements. Thus, shade and

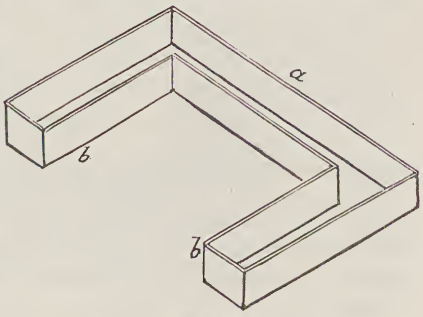


FIG. 119.

uniformity of temperature we have shown to be essential; and this can best be got by one of three methods: either by arranging the apartments as in Fig. 119, like the letter E; as in Fig. 120, like the letter I; or as in Fig. 121, in the form of a square, with an internal quadrangle reached by proper entrances. In all of these the letter *a* indicates the position of the north side, to which all the windows of the milk apartments open. Each of these arrangements has its own advantages which the others do not possess, so that it is exceedingly difficult to decide between their opposing claims. The plan in Fig. 119 gives shade room, so to call it, on one side only, and that also on the side where most it is required—namely, on the south side, as at *b b*; while that in Fig. 120 gives it on both sides *a* and *b*, Fig. 121 giving it on all sides at one period of the day or other. Of the three systems, that in Fig. 120 is perhaps, on the whole, the best as regards arrangement; and as regards economy in roof construction it is perhaps the best also. Assuming, therefore, it to be the "system of arrangement" adopted, let us see how we can arrange under its roof the various apartments necessary to carry on the work of a large dairy farm. For our purposes it is not necessary to go into such details as will require dimensions to be stated, these being dependent upon circumstances which will obviously change with every locality, &c., &c. What we have to concern ourselves with, is the statement of general principles and of leading facts.

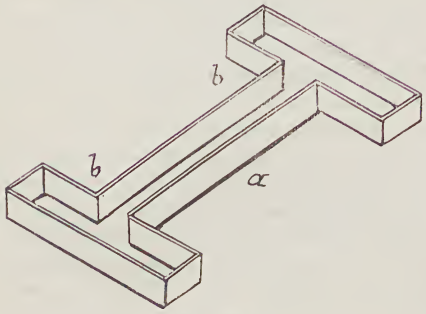


FIG. 120.

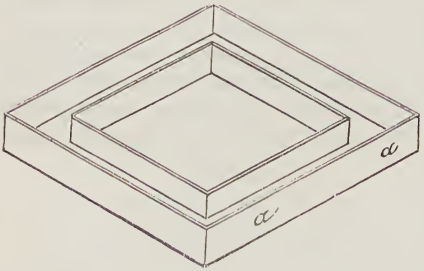


FIG. 121.

Assuming the rough sketch in Fig. 122 to be the plan, without, as before stated, having reference to scale or dimensions, of the dairy

as arranged in the general principles indicated in Fig. 120, the first or starting point is the connection with the cow house or byre. This in the plan is on the east side of the general run of plan in Fig. 122, and should, for the reasons already given, be as far as possible from the milk room. Any inconveniences as to distance can be got over by having a tramway, the incline of which should be down towards the dairy buildings. This tram is indicated in Fig. 122 at *a a*, the direction of incline being in the direction of the arrow *b*. The milk house, *c c*, has all its windows towards the north side. In the plan there is an exception to this principle, inasmuch, as in the milk room, marked *d d*, its position prevents this being carried out. But the next best position is the east, and it is on this side on which they are placed. But it might be asked why have two milk rooms? This plan is adopted on the suggestion of an able and practical authority who strongly recommended it to the writer in cases where large bodies of milk were dealt with, and for this reason: We have already stated that milk is what may be called an extremely "sensitive" body or substance — sensitive alike to taints and smells, which it takes up with remarkable quickness and certainty, and sensitive to all the variations in temperature

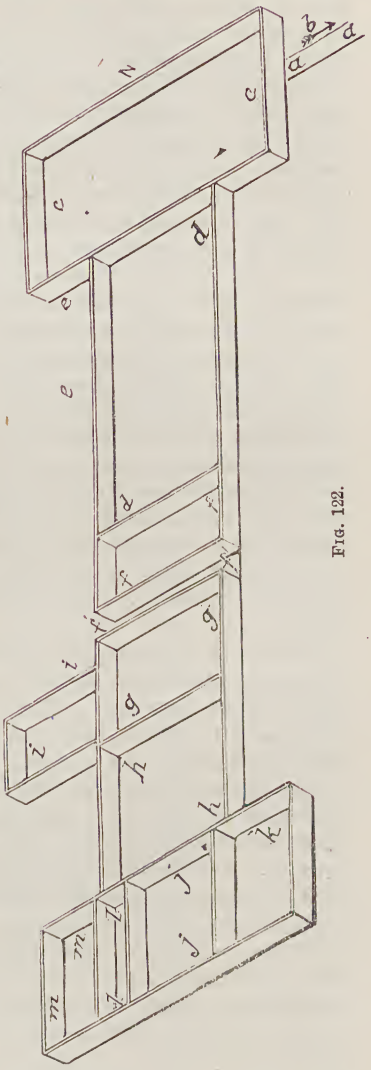


Fig. 122.

continually going on around us. Now, these variations in temperature have an influence, not merely in the giving the milk or cream which rises from it a tendency to sour, but they affect very considerably the regular formation of the cream, often, indeed, arresting it, or, at all events, in the least baneful of instances affecting its rise. Now, when the morning's milk from the cow house has been "put up," the great object is so to keep the temperature of the milk house as regular as possible; but when the evening's milk is introduced into it to be put up in its turn, its temperature is such, coming immediately from the cows, that it—strange as the fact may seem to some—materially affects the general temperature of the milk room, and acts upon the morning's milk in the way we have above indicated. The authority we have referred to found as the result of his experience this influence to be so marked that he strongly recommended the plan of having two milk rooms, one for the produce of the morning's, the other for that of the evening's milk. This has been adopted in the plan in Fig. 122. The system of cooling the milk by refrigerators or cooling apparatus was introduced in American dairies some time ago, and is being gradually introduced into dairy practice in this country. Should this plan be adopted, the milk room, marked *d d* in Fig. 122, might be used for this purpose, and for the general preparation of the milk for "putting up," such as straining it to remove hairs and other impurities with which, it may be here remarked, milk is much more largely tainted than some new to the subject might be disposed to believe, if made fully acquainted with details.

The milk room then being arranged as shown, the next part to be provided is the "cream-souring room." But we may here observe that, should the system of putting up the "whole milk" to be soured and churned be adopted, then a "milk-souring room" could be placed behind the milk room, *d d*, at *e e*.

These apartments make up what may be called the milk-keeping or storing rooms, forming the first department of the general plan—to secure as much as possible the isolation, which we have shown to be so essential in the keeping of milk or cream in perfect condition, or as near perfection as may be attainable. This department ought to be isolated from the next, which contains what may be called the working or making—or, as the favourite phrase is now so largely borrowed from quite another calling than that of farming, they may be termed the manufacturing rooms—by means of a passage at *f f*. With some it is a point whether something would not be attained in the more perfect keeping of the milk or cream or both from taints, &c., by having the milk room quite separate, as a building, from the making or

manufacturing rooms. The objection to this is, however, that the distance thus necessarily placed between them would involve extra labour and exposure to weather, &c. This, no doubt, might be lessened by having the two departments—however distant from each other it might be convenient to place them—built in the same straight line, so that they could be connected by a covered passage, making the floor of this inclined from the milk store room to the manufacturing department, and providing this with rails, so that the milk, &c., could be sent down in trucks, which, running by gravitation, would obviate all necessity to carry it by manual labour; and, being empty, those trucks could easily be taken up the incline with the vessels cleansed and ready to receive fresh supplies of milk or cream.

On inspection of the plan in Fig. 122 it will be observed that the isolation between the storing and manufacturing departments is carried out no further than by the placing of the passage (*f f'*) between them. This passage is, of course, covered over, to protect the attendants from getting wet, &c., in passing to and fro; but only covered at the point opposite, or, rather, above the points, at which the doors leading from the cream souring room in the first room of the manufacturing department, namely, the "churning room," (*g g*). If the "whole milk" be used from which to make the butter, the quantity or weight being bulky and heavy, considerable power will be required to work the churns. This power may either be best obtained from a turbine if water be obtainable in quantity, and at sufficient pressure, or by horse gearing, or by a steam engine. We prefer to recommend the latter when "power" is required; inasmuch as its boiler will or may be used to provide steam by which the water used for washing purposes can be heated. As, however a smaller boiler may do for this than that required for the engine, or required at times when the engine boiler is not in use, some may prefer to put down a special boiler for washing purposes; if so, the two boilers, or rather their furnaces, should be built close together, as one boiler and coal house will do for both, as well as one stalk. The position of this boiler house is shown at *i*, next to which is the steam-engine house, as shown in the plan, Fig. 122.

Next to the churning room, in which is placed the accommodation for making up the butter, is the "washing room" (*h h*), the supply of water being in this of the best quality. This is fitted up with all the necessary utensils. From this leads off the "cheese making room," or "vat room" (*j*), next to which is placed the "cheese press room" (*k k*). On the other side of the "vat room" is placed a "store room," which might be used as room for making up the butter, this being taken at once and placed in the ice room (*m m*).

Such is an ideal plan of a dairy, showing the apartments generally required for a large farm. These, of course, are capable of modification in relative positions, according to the notion of the designer or farmer. Thus the "washing house (*h h*) is, for the convenient service of the cheese and churning rooms, placed mid-way between them. But some would prefer this to be placed further from the latter. Fig. 123 shows an arrangement by which this may be carried out, in which *a* is a passage leading from the "churning room," *h h* in Fig. 122; *b*, the "vat room," corresponding to same apartment (*j j*) in Fig. 122 *c*, the "cheese room," corresponding to room *k* in Fig. 122; *d*, the "store room," corresponding to room *l*; and *e*, the "ice house," corresponding to same room in Fig. 122. Behind and outside of these is the "wash house" (*f*), entering from the end of the passage (*a*). This arrangement has the advantage named above, but the disadvantage of the wash house being thrown so much further from the "churning room" (*g g*) in Fig. 122, as the passage, *a*, is long.

Another modification of the plan in Fig. 122 is given in Fig. 124, in which the milk room (*a*), the cream souring room (*b*), and milk souring room (*c*) are placed in line at right angles to the central part of the building; *c* may be made an evening milk room, *a* being the morning room, *b* being the souring room. These rooms are separated by a passage (*d*) from the churning room (*e*), and this again by another passage (*f*) from the washing room (*g*) and vat room (*h*). The boiler house (*i*) is placed centrally between these two rooms, so that it will supply both with the hot water necessary. Other modifications of the plan in Fig. 122, or in parts of it, might be given, for changes in plans may be said to be endless, certain apartments being given; but we do not deem it necessary to go into any of these, but proceed at once to give a few notes on the fittings of the apartments we have named, and on some points of construction. Several of these we have already gone into, but the following may be taken as a general summary. We shall take the rooms in the order we give them in the plan in Fig. 122.

The milk room should be entered by a double door, so arranged that there will be a considerable space between them. This will best and cheapest be obtained by having a porch, and avoiding the necessity of a very thick wall. This double door will help greatly the means of equalising the temperature of the interior of the milk house. The windows should be also double —an arrangement indispensable in a well constructed milk room, as without it the temperature cannot be maintained. The space between the outer and inner window frames must be great enough to admit of the outer window leaves being opened inwards; and this will be best secured by throwing out the window

sills into projecting parts, like small bay windows. The best form of windows are those we have described when treating of stables. The roof and walls should also be double—the former having a space of at least six inches between the outer and slated roof and the inner and ceiled one. The best form for the interior ceiling is what is called a coach-house roof, higher in the centre than at the sides, but with the corners rounded off. The walls should be hollow or cavity walls, the usual space being about two inches. The milk room thus constructed will be surrounded with what may be called an envelope of air, which will form the best non-conductor of heat, and keep the temperature of the air in the interior of the room very equable through both summer and winter.

The floor should be so made as to facilitate the running off of the water used in cleaning it, and be of a material calculated to dry quickly. This will best be found in the Portland cement concrete, of which we have given a description, and ample instructions how best to use it. By its employment the gutters necessary to carry off the water can be made of any form and to run in any direction required, and this with the greatest ease.

Ventilation is essential in a milk room, this being attained by having a gentle but continuous current of air passing through it. The fresh air will be admitted in summer time by the windows, and those are so constructed that the entering air may be thrown in any direction required, up or down, to the right or to the left. Ventilating or air openings should be made in the walls a little above the line of ground floor, and these provided with valves capable of being easily opened and shut. The used air will be most easily got rid of by having air shafts in the roof, passing through openings made in the ceiling into shafts passing through the space between that and the slated roof, and the shafts should be provided with caps or ventilators. The more numerous the shafts and consequent openings in the ceiling the better, and they should be as uniformly distributed over it as possible. A good distribution would be one at each corner, and, if the room be very long, two between these at the sides and one at the ends, while a row, the number according to length of room, should go down the centre. We have elsewhere described a "ventilating ceiling," which, we believe, would form a most effective means of withdrawing the used air from an apartment. The principle upon which this is constructed is the arranging of laths or battens in such a way that a series of openings, rectangular or angular as desired, is made over the whole arch of ceiling. The air passes from the room through these openings to the space between the ceiling and the outer roof, and is withdrawn from this space by shafts in the latter, provided with caps or ventilators, or by louvre-boarded ventilators at the ridge. Another method—a modification of the

above, and a cheap one—is leaving out the ceiling laths for one or two intervals of breadth along the whole length and breadth of ceiling at the edge near the wall, and perhaps, or rather we should say certainly, one or two breadths at the crown or centre of the roof.

By opening the windows and ventilating apertures near the floor, the draught created will in many days during summer be sufficient to reduce the temperature to the required point. But if it does not, ice blocks placed in shallow tin vessels, close to the ventilating openings near the floor, will cool the air passing over them and still further reduce the temperature. Mr. Horsfall, an eminent authority on dairy management, used to wet the window blinds with cold water, the evaporation from which tended to reduce the temperature of the air. We have also recommended or suggested a modification of this plan "by having endless belts of calico stretching from floor to ceiling behind the milk shelves, and supported by and passing over rollers" at top and bottom. These belts will afford large evaporating surfaces, which surfaces will be very easily wetted by having the lower roller to revolve in a trough of water; and from time to time the belts may be moved round by the dairymaid so as to wet the whole surface. It is right to state that recent researches and experiments seem likely to modify very materially the generally received opinions as to ventilation of dairies, and the effect of this and of cooling upon the milk.

Another method used in some dairies is to have the milk coolers, or vessels in which the milk is put up, placed in open troughs, so as to have a supply of cold—further cooled in very hot weather by ice—water flowing continually past them. The troughs are placed on iron pedestals secured at intervals to the floor, and the trough is higher at one end than another, so as to enable the water to flow slowly from the upper to the lower end. In other cases the milk coolers are placed upon cast-iron shelves, not solid, but of open work, and beneath the shelves the cold water troughs are placed. Where solid shelves are used, the worst material to form them of is wood, as it is apt to get tainted by the spilling of the milk upon its surface, which is very difficult thoroughly to wash out. The best material is marble, the next best slate. Of whatever material made —iron, wood, marble, or slate—the shelves should be kept forward from the wall, so as to allow a free space behind their edges next the wall, and the face of the wall. This free or open space is of great value in enabling the washing and drying cloths to be put in by the hand, so as to clean thoroughly the inner edge of the shelves. When they are put close up to the wall, a corner is formed, which is very difficult to keep clean and free from dust and decomposing matter.

Of the other permanent fittings of the milk room is the apparatus for

heating it, or raising the temperature of the room in winter weather. For large dairies the choice lies between steam and hot-water pipe apparatus, and of these, certainly, the most conveniently arranged and kept in working order is the hot-water pipe system; the temperature, moreover, is more easily regulated with hot water than with steam pipes.

The walls of the milk room, up to a height of at least two feet, should be lined with glazed encaustic tiles—white looks the cleanest—which are easily washed and kept clean and free from all matter likely to taint the milk. A lining almost as good and much more economical will be a coating of pure cement concrete, made and laid as hereafter described in connection with the washing room.

The constructive details of the cream room are very similar to those of the milk room; the fittings comprising ranges of shelves only. The churning room fittings come more under the class of work of the engineer and mechanic than of the architect. The chief permanent fixture is the table for making the "butter up," &c. This will be best of marble, with its upper surface slightly hollowed out, the hollow being deeper at one end, the left hand, than at the other or right hand. Water, both cold and hot, should be laid on to this table.

The washing-room floor will require to be laid with scrupulous care, so that there will be no leakage; and in order that the evaporation from its surface be as quick as it possibly can be, it will be well to make the upper surface of a fine coating, carefully laid on, about half an inch thick, of the Portland cement concrete, made with fine sand, and a higher proportion of cement. If this is well done, a floor particularly hard, smooth, and almost as fine in grain as marble may be obtained. Before it is dry, the whole surface should be gone over with a large, smooth-faced hard-wood board, provided with handles; this will give the requisite smoothness and uniformity of surface. By mixing colour with the upper layer of cement, the desired colour may be given in the surface. The contour of the surface should be such, so that the centre will be higher than the sides, allowing the water to shoot freely off to right and left sides. At these points the open gutter should be made. These should not go quite close up to the wall, but a margin of floor space should be left all round. The gutter should be rounded at bottom by means of a gauge of wood, and the sharp corners also rounded off, when the cement is soft, by means of a trowel, so that the water will run easily off; and, further, no parts be left which can be easily broken off, as sharp corners usually are.

The ventilation of the washing room will require to be well devised, so that a much sharper and quicker change of the atmosphere be secured than in the case of the milk room. This is necessary in consequence of the large volumes of steam or vapour arising from the hot water used in scald-

ing the various vessels. In view of the great amount of vapour in the house when in full work, it would be well to line the walls with cement concrete, which does not absorb the damp like other materials, and which will dry very rapidly in consequence. The ceiling should be made very sloping, rising considerably towards the centre, and this also will be better if of brick, with cement concrete, than if plastered in the usual way. The point may be raised for discussion here whether an open timbered roof, with louvre boarded ventilators at the ridge, would not be better than the interior ceiling with the ventilating arrangements we have described. We should be inclined to recommend louvre boarded ventilators if they could be depended upon for working always in all winds effectively, which, however, they cannot; often, indeed, acting as beaters down of the air or vapour into, in place of it being withdrawn out of, the room. Watson's ventilators are very efficient, so also are the screw ventilators. But we may, perhaps, be pardoned for stating that we believe the sliding, or rolling ventilators, which we designed some years ago, and of which several have been fitted up, would be the most efficient. They give all the advantages of a building of which the roof, so to say, can be instantaneously lifted off, and as instantaneously lifted back again, with the power of being moved from the smallest up to the widest amount of opening with ease and facility.

The cheese vat room, as regards construction, is very much alike to the milk room, but has some points in it of the washing room, as the floor and walls.

The Ice Sheds.

The ice house is a feature peculiar to all modern dairies of any pretensions to completeness and efficiency of arrangement. The Americans excel in the construction and arrangement of such structures, as nearly every house of any size, especially in the country, has its ice house, the ice being used for a variety of purposes, and in modes to which we have no parallel in this country. The designs for ice houses in America may be considered, therefore, to be very complete; they are certainly numerous, both as regards plan and methods of construction. The first points to be aimed at, it is scarcely necessary to say, are first to prevent the ice from melting; thus necessitating complete isolation from the atmosphere, and at the same time a ready means of getting at the isolated materials. These two points are directly antagonistic, one would suppose, and to a large extent they are so, for the more hermeti cally sealed the ice house is, the more completely is the ice kept from contact with the open air, which is always—save during hard frost—at a much higher temperature than the ice; and each time air enters

the house this sealing is broken; and yet, by a careful arrangement of the house, the ice is kept in such a melting climate as America has during summer without scarcely any meltage, if we may coin a word. There are, as we have said, many ways of arranging ice houses and of constructing them, but our space obviously does not admit of our giving them. We must simply content ourselves by explaining very briefly the principal points in their arrangement and construction.

There are two methods in general use, the first being a building in an excavation of the soil, the plan being either circular or rectangular, with the walls sloping very much, the narrow end being lowest. The second plan is constructing the building on the ground, and having the roof and bottom arched. In both the walls are cavities, or are double and bounded with a trench, into which non-conducting materials are rammed. Drains are essential to carry off the ice-melted water. The details of entrance passages, &c., will suggest themselves to the reader. The doors, in all cases, should be double, so as to admit of the free space between each being filled in with straw.

The experience obtained in connection with the Swedish butter-making factories would point apparently to a much more simple method of making ice houses, or rather of preserving ice, than any of the methods introduced generally. In these factories, in point of fact, an ice house is entirely dispensed with in the sense of having a structure allied to a house. The plan is simply this: A space, either in the open air or within an open shed, is cleared on the ground, equal in diameter, or dimensions if rectangular, to the intended size of base of ice pile or heap. This space is covered carefully to a depth at least of twelve inches with sawdust, tan, bark, peat, ashes, or other thoroughly good nonconducting material; then the ice is built regularly upon this in layers as equal as possible, care being taken to fill the interstices between the blocks of ice with the same non-conducting material. When the pile is completed, it is then carefully covered over with a layer of the non-conducting material from top to bottom. When any ice is required to be taken from the pile, it is removed from the upper part first, so that the ground or soil is ultimately reached. In taking any ice from the pile, the part uncovered in doing so is again most carefully covered up with the non-conducting material. By this method ice keeps all the year round in good condition, the loss from leakage amounting, it is said, to twenty-five per cent. only.

PART IV.—RESIDENCES.

Country Houses.

The house question naturally divides itself into two great divisions—cottages for the class who cannot, and those for the class who can build for themselves. The subject for the first of those two classes is that to which great prominence has been given for many years, and which is perhaps best known under the title of the "Labourers' Cottage Question," and has taken its place as one not the least important of those social questions which have attracted and is still now attracting our attention as a community. As connected with the second class above referred to, it obviously comes under quite another category, and embraces those points which are more connected with the domain of taste, and the combination of comfort with elegance, than that of philanthropy. To the requirements of this class we devote some attention, giving, for reasons which do not require here specially to be named, the greater attention to those points connected with the healthy conveniences than to the elegancies, and, as some may say, the "prettinesses" of cottage residences. Much of this kind and character of information will clearly apply to the cottages in which the labourer is to spend his life, so far, at least, as health is concerned; for what tends to keep the labourer and his family well, so far as house construction can do so, will also tend to keep those well who are blessed with a larger share of the world's good things. The principles of *healthy* construction are applicable to all classes of houses.

The various points which should be taken into consideration by those who propose to build may be classed under one or other of the following heads: First, the *plan* of the cottage we desire to have; the *site* upon which we propose to place it; and third, the way in which we propose to embody in its *construction* all those details which will secure at once economy and health. Of these three—plan, site, and construction—we shall take up the "plan" first.

Domestic architecture we may conceive to be divided into two classes of operations—those which concern themselves with the securing to the

inmates of houses the comforts arising from arrangement of the apartments, and the kinds or character of the apartments themselves—this coming under the head of planning; the second class of considerations concerning themselves with the health of the inmates, and those coming under the head of construction. In some instances the two run closely into each other, in some also they are inseparably connected; still, there is such a marked diversity between the two classes of operations that we are justified in making and adopting the classification—for it is obvious that the apartments of a house may be so constructed in accordance with sanitary science that they may be very healthy to live in; yet they may be so arranged or so deficient in number that they will be very inconvenient to live in when considered as a house in which certain domestic operations are to be carried on.

That the planning of a domestic structure, whether that be a farmhouse of the first class, a cottage for the bailiff, or the simplest of cottages for the labourer, should be carefully gone into, and all the points duly considered, is obvious on the briefest consideration; and, if for no other reason, for this, that mistakes once made in the plan, and perpetuated in the building, cannot be afterwards rectified. In setting to "plan," the first requisite is to know what you want—that is, the accommodation and conveniences you would desire your house to have. If you have the ability to sketch out a plan, no matter how roughly it may be done, so much the better; for you can then be able to see graphically the relation of one room to another; and how the placing of this apartment here, or that apartment there, will add very much to the convenience of the house. The position of doors, windows, and fireplaces should not be overlooked, and, what is of equal importance, the relation of these to one another. The most awkward blunders are perpetrated sometimes, even by skilled architects, in placing the above conveniences in such positions that the apartments are not only uncomfortable, but they are so cut up that furniture cannot be conveniently placed on them. The position of the stairs and the landing exercises a very decided influence upon the convenient arrangement of a house. We have known these to be so arranged that furniture could not be got into the upper rooms from the inside of the house, but had to be taken in by the windows. The position of the window or windows of a room with relation to the fireplace is also of importance, more especially in the kitchen. A fireplace may be so situated that the cook will always literally be standing in her own light. The mere hanging of doors, simple as this appears to be, may be done in such a way that it will materially add to the convenience or inconvenience of a room, according to the way it be done, good or bad. This is specially the case where the rooms and passages are small and confined. A closet, for

example, may be made either a convenience or the reverse, simply by the way in which the door is hung, that is, according to the way in which it is made to open or shut. A large part of a pantry may be rendered wholly or partially useless, or at all events very inconvenient, by hanging the door in the wrong way.

The lighting of a closet or pantry, or rather the way in which the light is admitted to it, depends frequently very much on the way in which the door is hung. Another point, often overlooked, is the providing of pantries and closets; but it should never be forgotten that a "convenience" may be so placed that it may be very inconvenient to the house-

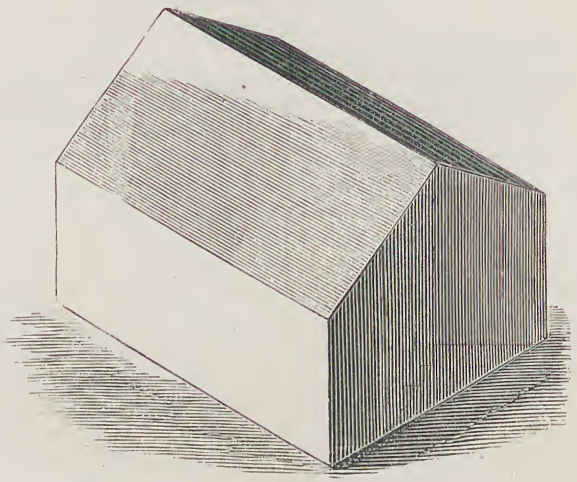


FIG. 123.

keeper. Conveniences are not only required in a house, but they must be conveniently placed.

All these and other points are here named in a cursory way, simply to impress upon our readers that the planning of a house is an operation which demands and must obtain, if success be desired, ample time and serious consideration to be given to it.

One mistake often made, and to which we have more than once drawn attention, is making the design of the house, or the predetermined in design, dictate the plan in place of the plan dictating what the design should be. The primary point, we take it, to be aimed at in building a house is that it shall give the maximum of comfortable convenience at the minimum of cost—that it be, in fact, a "place to live in, not to look

at" merely. This can only be attained by careful planning ; and after the plan has been decided upon, in other words, after it is made clear what the house is to be made up of, how many the apartments, how most conveniently they are to be placed in relation to each other, so that the "living" of its inmates can best be carried out; then, and not till then, should the "design"—which is to be the shell which covers the kernel —be thought of, and he will be but a poor architect and by no means fertile in design, if he cannot give to the good kernel a handsome and tasteful shell.

Much of the character of a house, so far as the external design is concerned, will no doubt be dependent upon the outline which the plan presents, and this relation of the internal plan to the external design

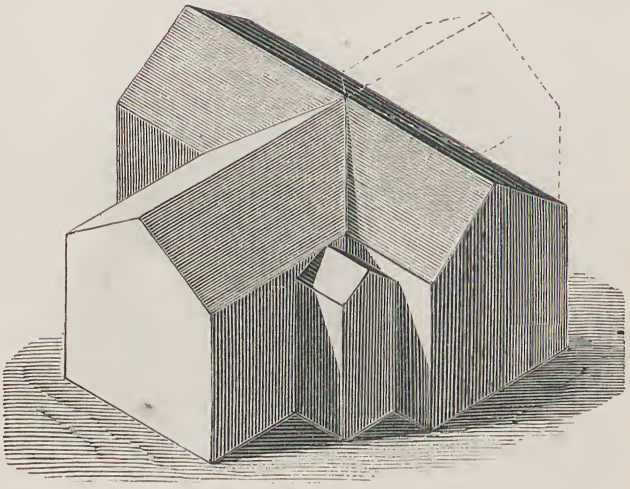


Fig. 124.

of the house may be studied with good effect. This points to the form which the plan assumes, and this again is dependent upon the way in which the various apartments are massed or outlined together, making up the house as a whole. And this outline in turn influences the cost of a house. The same expense incurred in giving a certain amount of roofing and walling will not give, as a matter of course, the same amount of accommodation. The dearest house in these departments may give the house with the least accommodation. Where economy has, therefore, to be studied in house construction, due consideration must be given to the form or outline, as that will exercise an influence upon the

cost. The cheapest form is that of a rectangle, as it admits of the application of the cheapest form of roof, this being uniform throughout, and having no "breaks" in it (see Fig. 123). No doubt the outline of a house of this form is "plain to ugliness," and the style is frequently in derision called the "tea box;" but a square house admits of a great deal of good planning, and may be made very comfortable and convenient.

It is, however, beyond a doubt that a house with broken outline, that is, with projecting and receding parts, is much more picturesque and pleasing to the eye than a house as in Fig. 123. This is shown in the sketch in Fig. 124, which also shows, however, that its roof will be a dear one as compared with that of Fig. 123. The fewer the breaks in a roof the

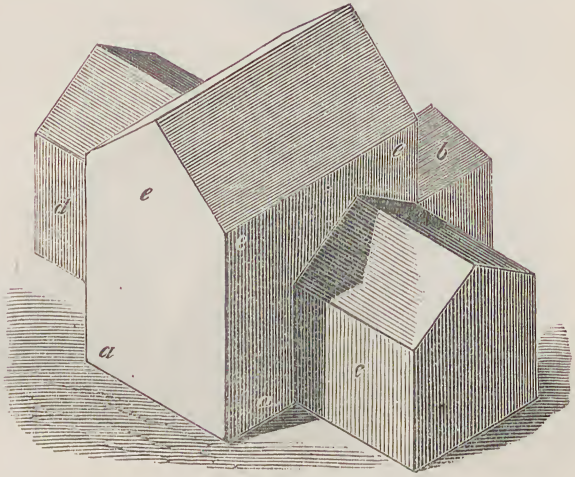


Fig. 125.

cheaper it is, not merely in first cost, but in the after keeping of it in good order. As a rule, it may be set down that the largest proportion of the charges upon houses for keeping them in repair is expended upon the roof; and that plain running roofs, with few or no "valleys" will be easier kept in repair than those of broken outline, with many valleys or angular junctions. Some roofs cost nearly twice as much as they should do, and that simply from the peculiarities of the plan of the house, which might have been such that the same roof would have covered nearly twice as much accommodation. Take, by way of example, Fig. 125, which is an outline sketch of a cottage, which forms an exceedingly

effective design in the "half-timbered style," and this mainly from the inequality in the heights of the vertical and the breaks in the horizontal parts of the design. In the ground plan of this the accommodation consists of the living room in the central part, *a a*; a scullery and closet, in the "set off," or projecting part at the back, as at *b*; a bed room in the wing, *c*; and a corresponding room in the wing, *d*. But these wings are only one storey high, the central part, *a a*, being only two-storeyed, and all the accommodation obtained is one bed room. Now in this case we have the maximum of roof with the minimum of accommodation. The same roof would cover a good amount of extra accommodation by moving up the walls of the wings, *c* and *d*, to the level of those of the central part, *a a*; or, by altering the plan, the same accommodation could have been obtained with a much less costly roof. It must be remembered that we are discussing the point of economical construction. Of course, where a cottage, pretty to look at and designed specially to form an ornamental feature in a park or an estate, is required, there is no more to be said. If the expense is no object, no doubt a beautiful object is worth having much more than a plain or positively ugly one.

This roof question is, the reader will perceive, closely connected with that of one-storeyed and two-storeyed cottages so often discussed, and which, like every other question, is one not likely to be settled to the satisfaction of the two parties who join in the discussion. Where it is a mere matter of taste, it cannot be thus settled; for the one party admits of no "standard of taste" but his own, and conceives that of the other party as being no taste at all, or one irretrievably and inevitably bad. But if economical and sanitary considerations are to be taken into account as the points which are to settle the discussion, there can be little doubt that it will be settled in favour of the two-storeyed cottage. So far as the roof point is concerned, in a two-storeyed cottage it obviously covers twice the amount of accommodation which that of a single or one-storeyed cottage does. No doubt there is the cost of the extra walling in the case of a two-storeyed cottage; but this will not be so great as that of the roof, and in repair will not cost a tithe of the expense. Take the accommodation which a two-storeyed house gives, spread it out so as to make a one-storeyed cottage, and the difference in cost will be very striking; to say nothing of the wide expanse of roof to be kept in repair. The case is still more pointed if we take that class of cottage which is neither one-storeyed nor two-storeyed, but where the place of a proper second storey is taken up by those wretched apartments called "attics," as in Fig. 126. The name here given them is well earned, for with their walls of unequal height, with part of the

floor space useless, and so immediately under the roof as to be too hot in summer and too cold in winter, the accommodation given by them is neither convenient nor healthy. A very little extra expense would give as much height of wall as to make the whole floor space useful, and the rooms in every way more convenient.

Then, as regards the sanitary points of the question; we believe them to be altogether in favour of two-storeyed houses. The bed rooms in these are raised considerably above the ground; and this, in a climate such as this is, and where the tendency to become damp, which all houses have to a greater or less degree, is a matter of great importance where health is concerned. This question of single as against two-storeyed cottages has a very important bearing upon that of the labourer's cottage. Num-

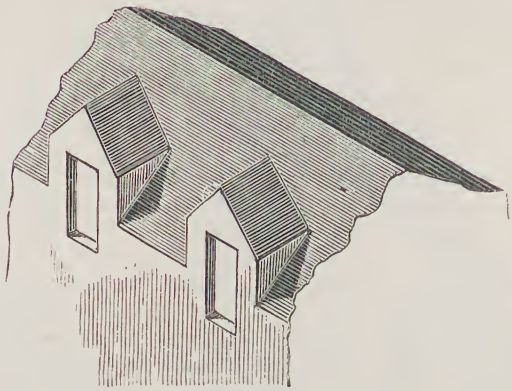


Fig. 126.

bers of single-storeyed cottages have been built, the roof of each of which would have covered twice the accommodation. And if it be said that the accommodation in the second storey was not required, the difficulty could easily have been got over by the adoption of what has been named the "composite" style of cottage, but which may be here described as a plan of making one roof cover two cottages—one cottage entering below from the front, the other by stairs at the back.

We have thus run over very briefly several points bearing upon the subject of planning, chiefly with a view to show the importance of this; and that it affects not merely the conveniences which the house may give for living in, and for carrying out the various departments of housekeeping in the easiest way, but, what is perhaps less obvious, and what is certainly less thought of in connection with the subject, namely, the

economy with which the house may be built, and also the health of those who are to inhabit it.

Having given a few hints on the various points bearing upon econo-

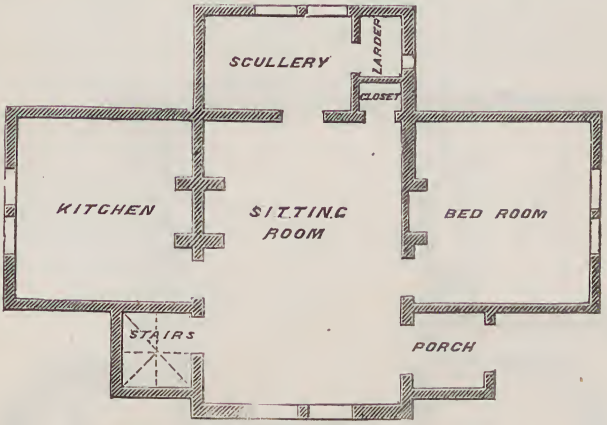


FIG. 127.

mical construction and arrangement, and how that was affected by the mere plan of the house, and having cited cases in which the plan and

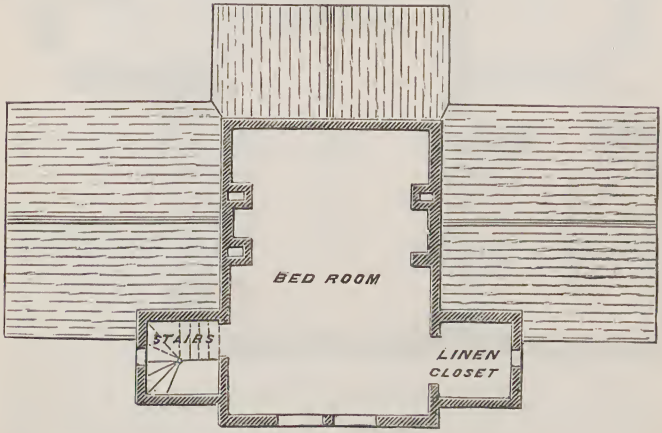


FIG. 128.

style of the house might cause a large amount to be needlessly thrown away upon roof space which would cover no really useful accommodation,

we now give here one or two further illustrations, as thus, in Fig. 5, which is the ground plan of a small cottage *ornée*, which can give no doubt a very effective elevation with broken outline of roof; but so far as the accommodation covered by that roof in the second storey is concerned, that storey might as well not have been given. Glancing at the chamber plan in Fig. 128, we see how large

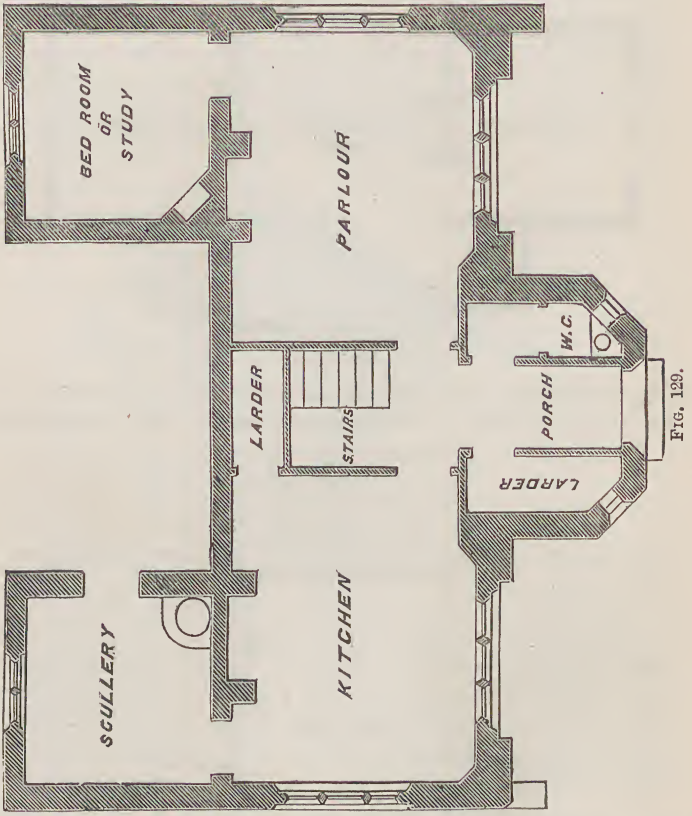


Fig. 129.

a proportion of the plan is occupied by the roof, and we have already pointed out how costly an item this is in the erection of a house. In Fig. 129, we give plans illustrating the same feature; although in this case the fault is not so striking as in the last (Figs. 127 and 128), Fig. 130 being the chamber plan of Fig. 129. We conclude our remarks upon this

important department of our subject by stating that, in all cases where it can possibly be done, the plan of a house should be so arranged that all roof space should be utilised by covering as much available accommodation as possible in both storeys of a double-storeyed house; that all partitions should, if possible, be carried right up from first to second storeys, necessitating as little cutting up of the space of the second

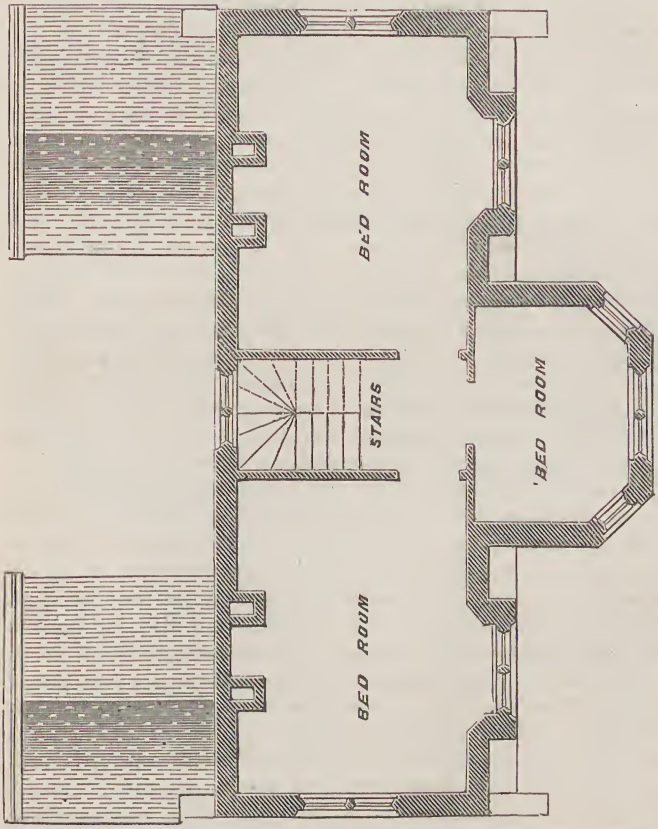


Fig. 130.

storey as may be, by hollow quartering partitions; and that where the highest degree of economy in construction be desiderated, then the accommodation required should be given in a double-storeyed house, the one roof thus covering double the accommodation it would do if the house were one-storeyed.

We have not yet, however, done with all the circumstances affecting the economical arrangement and construction of a house, having to point out the influence which the mere form or outline has upon this. This may be exemplified in a very marked manner in plans where there are many breaks and offsets, making the roof of necessity broken in outline, and correspondingly expensive. But we here refer specially to the exact form or outline of the plan or house in which a square is set against a rectangle, having unequal sides. A writer on the subject of house construction, whose remarks upon the whole subject deserve to be better known than they are, states that "a rectangular building, formed by four equal sides (or square form), incloses a larger space than any other rectangular form; and that as the square form is deviated from, a loss of space inclosed or superficial area is the consequence in rapid proportion as the length exceeds the breadth. Thus, a line 100ft. in length, made to form a square of 25ft. in length by 25ft. in breadth, will inclose a superficial area of 625 square feet. But if the same line (of 100ft.) be unequally divided so as to form a rectangle, such as 35ft. long by 15ft. broad, the area thus inclosed will only be 525 square feet. Hence, by thus simply altering the form of the space or area inclosed by the walls (not by altering the extent of the walls themselves) 100 square feet of it are lost. Now, in the case of a house inclosed by any length of wall, and in any similar manner, the loss of space would be in the same proportion, which lost space might have been saved by being inclosed by the same length of wall; and for the same cost, if a different form (the square) for the building had been adopted. This circumstance is obviously one of great importance in the economical construction of houses; although it does not seem to have been attended to as it deserves. It forms a rule, however, to be kept in view where the greatest extent of space is desired at least cost." Where the houses or cottages are built semi-detached (or in pairs) or in rows, this square form may have to be modified to meet the exigencies of the party walls, fireplaces, windows, doors, &c.; but still the nearest possible approach to the square form should be made. Where the houses are semi-detached, that is, in pairs, the most economical proportion between the length and breadth of the two is found to be as three to two. If, to what may be called the shell or internal form of the plan primarily inclosing the accommodation, external offshoots be added, it is obvious that the expense of the building will be increased in proportion to the number and to the varied form or outline of those—and this whether the form of the "shell," so to call it, be square or unequal sided; and yet, so far as what are called picturesque effects in rural structures are concerned, these, in the opinion of some, can only be obtained by giving these offshoots or breaks to the original

outline of the house. And it is right to state that these are capable of being added with much greater and more picturesque effect to houses of

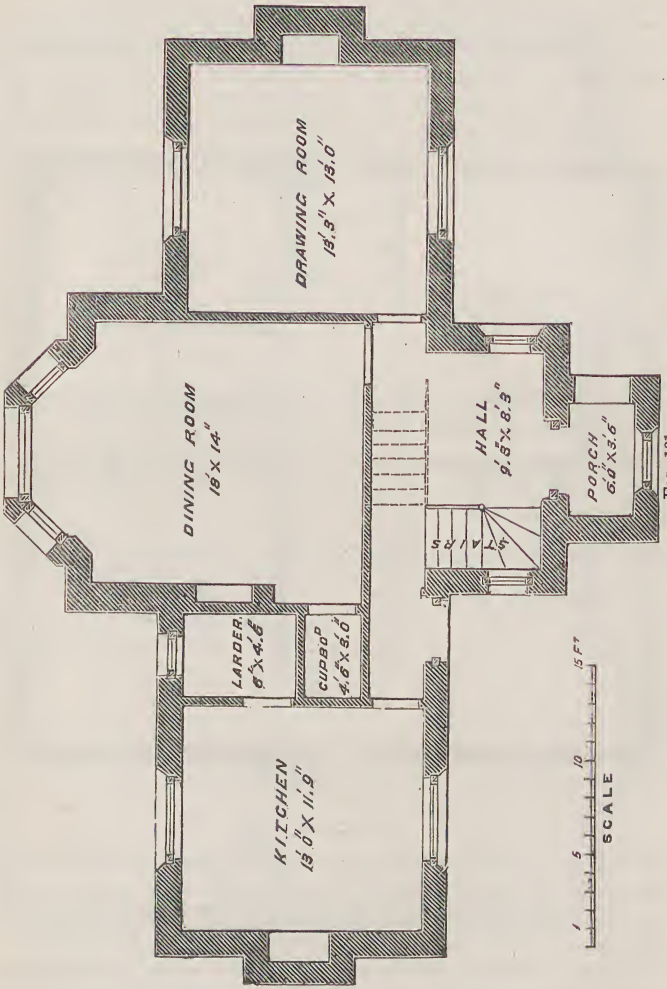


Fig. 131.

which the outline is unequal sided, as in Fig. 131, than to houses in which the outline is equal sided or square, or nearly so, as in Fig. 132. Although

square-built houses are destitute of picturesqueness of outline, still much can be done in the way of adding beauty by training plants of various kinds, or by giving ornamental work to the eaves, doors, and windows, as is done with such striking character to the square houses abroad; and which, by the way, are much more numerous there than with us. Much might be done by relieving the bald bareness of square houses by the means above suggested, and also by adopting a new style of roof. By a judicious arrangement of the roof outline, and of the position

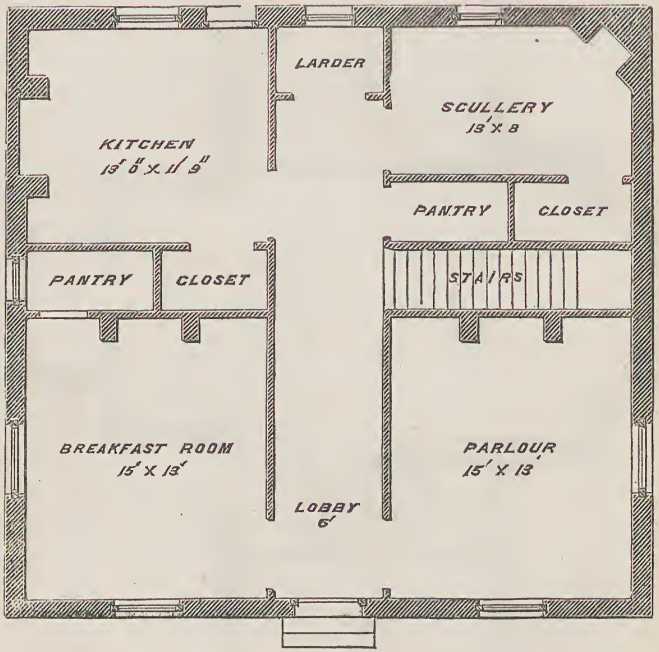


Fig. 132.

and form of the chimneys, much can be done to raise the architectural character of the exterior of square houses, making this of as high a class as is that of their interior, so far as convenience and economy of arrangement can be given, by means of the mere outline or form of the house.

It is not easy to classify the different kinds of houses, or rather their plans, although sundry attempts have been made to do so, but, as may be guessed, with doubtful success, for it is obvious that there may be no limit to the vagaries or varieties of planning, or no end to the ways in

which combinations of apartments may be placed together. But in examining a very wide variety of plans of houses actually erected, or planned for the purpose of being so, we shall find that there is a kind

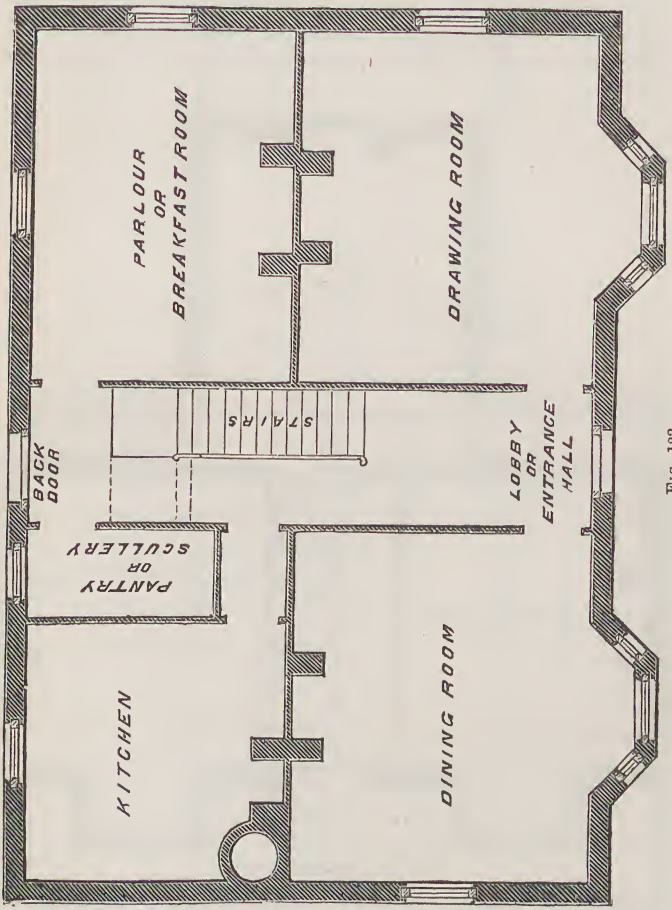


Fig. 133.

of "law," so to say, existing by which, or under the influence of which, the plans range themselves under certain forms, which may be taken as "types" or models. Thus, so far as houses of a superior class—that is, not cottages for the labourer—are concerned, and taking the kind

known as "detached," or single houses, that chiefly required in rural districts, where the semi-detached or row of houses are rarely met with, we find that these types may be classified as follows: First, the "square" or "nearly square" house, of which in Fig. 132 we give a ground plan. Second, the "rectangular" or "oblong," of which we give, in Fig. 133, ground plan, and in which the apartments are two deep, so to say, and

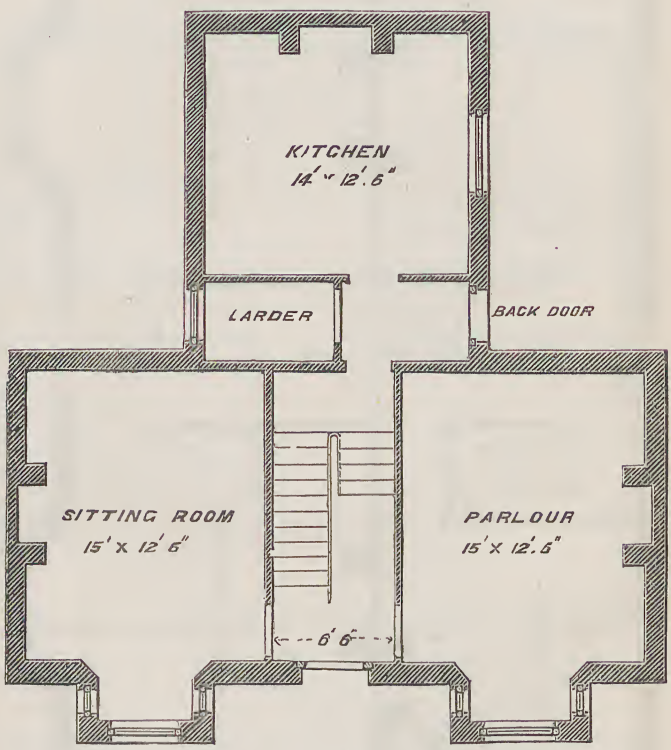


Fig. 134.

which may therefore be called the "double rectangular or oblong," as distinguished from the third type, in which the oblong characteristic is displayed, but the apartments are only one deep, and have an "off-set" or projecting part at the back, as shown in ground plan in Fig. 134. The fourth type is the square, or nearly square, as in Fig. 132, but with an "off-set" at the back, as in Fig. 134. This fourth type is illustrated in ground

plan in Fig. 135. The fifth and last type we here concern ourselves with is illustrated in one of its many forms in ground plan in Fig. 131. This type may be called that of the "break and projection," and if an artistic

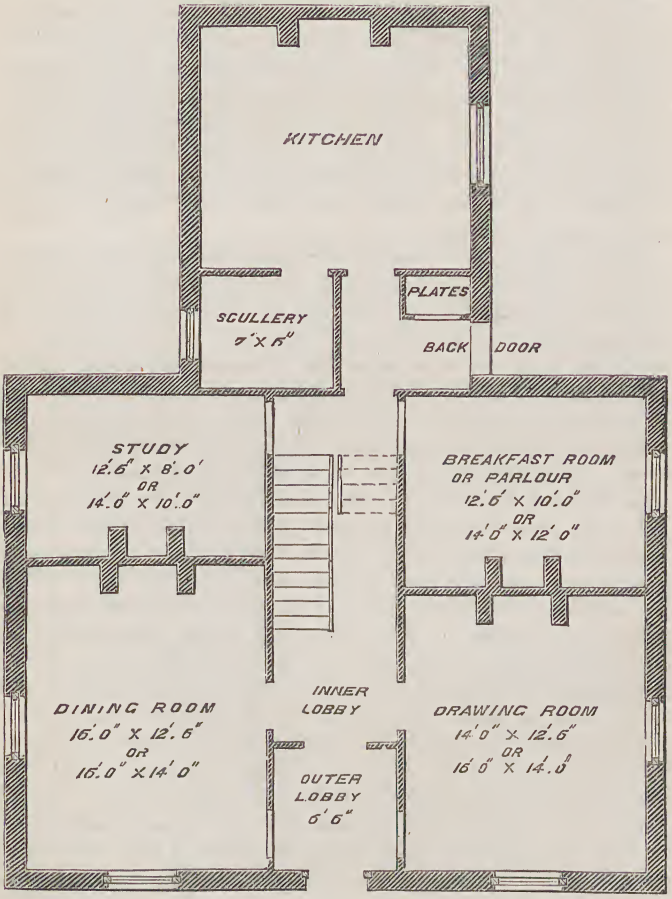


Fig. 135.

name be desiderated for it, we may call it the "picturesque," as opposed to the first type in Fig. 132, for which we may find a fitting name in the "plain" style of house plan. The type in Fig. 131 may be varied to a very

great extent by placing the off-sets and breaks in various positions. Which of these "types" is the most popular nowadays we need scarcely say. Fig. 131, or the fifth type, takes the lead, but it does so in every way —that of expense as well.

In considering the arrangement of the house, that is, the relation of the rooms one to another, it is at once obvious, one would think, that those upon which the comfort of the inhabitants is mainly dependent would receive the most attention, so as to secure the greatest efficiency. But it is not always so. Let it be a maxim in the planning of a house, or in looking at a plan which may be prepared for a client, to give the greatest amount of attention to those parts of the house in which the most work is done, and to and from which much "traffic" is carried on every hour of the day.

Keeping this in view, one of the first points which will demand attention will be the kitchen. To place this in the best position, so that, while it be so near to the entertaining room that the labour on the part of the servants, going to and fro at meal times, &c., shall be reduced to a minimum, it will be so far away that the smells, &c., arising from the cooking shall be also so reduced, must be the object in view. Obviously, if perfection of position—so far as the odours of the kitchen are concerned—be desired, this apartment should be placed at the top of the house; the cooked meats, &c., being sent down by means of a lift. This, however, is a plan not likely to be adopted, for many reasons. Where the kitchen is properly ventilated, and where the further precaution is taken of having double doors between it and that part occupied by the entertaining rooms, much inconvenience arising from the odours of cooking need not be anticipated. The kitchen should be of large dimensions —as large as possible. A small, cramped-up kitchen, is one in which it is impossible to do the work well, and frequently—too frequently—this apartment is the most inconvenient in the house, and this chiefly from its being made so small. The position of the fireplace relative to the windows should be well studied, for upon this will depend whether the cook will be able to see what she is doing at her fire. Side lights are always better than lights in front of or facing the fire. Opposite lights—that is, windows facing each other—are strongly recommended by some, as yielding a strong light. Be this as it may, the arrangement undoubtedly possesses this great advantage, that, by opening the two windows at the same time, a thorough draught will be established through the kitchen, sweeping off much of the odour of cooking, &c.

An essential adjunct of the kitchen is what in some districts is called the "back kitchen," more generally in others the "scullery." This should enter immediately from the kitchen, and be of pretty large dimensions.

As a rule, this apartment is made too small; and, indeed, in many houses, so small that it is of no practical use, and the space would have been better devoted to the making of a pantry or closet. The scullery should have a large washing or slop stone well supplied with water, both hot and cold; and the window should be large enough to give abundance of light. It is a question much debated whether the scullery should have a door leading to the back premises, independent of that leading from the kitchen. We incline to the opinion that, for mere convenience sake, a back door will be a good thing in the scullery; but for comfort it is questionable whether it should be given, as the draught thereby occasioned will make the kitchen rather cold in winter. In some houses the scullery is made large enough to contain a fireplace, in addition to that of the boiler or copper.

Next in importance to the scullery, as an adjunct to the kitchen, stand the pantries, closets, and larders, which should all be close to it. If the house is pretentious enough to possess a housekeeper's room, then this should be so arranged, with relation to the kitchen and the pantries, closets, and larders, that all shall be within easy reach; they should not be scattered up and down the house, necessitating the running to and fro and consequent waste of time. Whether this concentrated and convenient arrangement can be obtained or no, is a point for the architect to decide; but he should decide that the house shall possess as many as possible of these conveniences for storing. It is not possible scarcely to give a house too many of them.

The next adjunct to the kitchen is the washing house; but in small and moderately large houses the scullery can be, and is, used for this; and in very large establishments we recommend the wash-house to be placed in a building outside the house, with laundry, ironing, drying rooms, &c., attached. In connection with the coal and wood house, which can be very conveniently placed in the cellar apartments, a small place should be given for the cleaning of boots and knives, &c. If no cellar apartments are given in the house, the coal house should be outside, and may be arranged so that it can be entered from the scullery. It will, however, be cleaner and better if the entrance be outside; and to keep the path to the coal house dry, it may be covered with a verandah projecting from the side of the house, and covering the back door; part of this verandah may be used as the knife-cleaning place, a stone bench being placed in the corner for this.

We have above alluded to the "cellar" apartments of a house. It is odd to note the different meanings attached to the same thing in different districts, and this is very marked in connection with building. Thus, in some districts, any small outhouse used to store up coals, wood, timber,

&c., is called a "cellar," this being understood to apply to buildings having purposes as above named in view; whereas in other districts a cellar is an apartment under the usual or normal ground level on which the house is built, and immediately under one or more of the upper apartments or rooms of the house. This is, in fact, the correct acceptation or meaning of the term, and is equivalent to the French "cave," which designates an apartment the same as a "cellar" under its more correct term. Hence, when we use the term cellar, it will refer to any apartment or apartments placed under the ground level of the house. Apartments of this kind are almost universal in the North of England, and are there deservedly popular. We do not advocate their use as living apartments, but for many purposes they can be made admirably convenient; and, beyond all doubt, they are unrivalled amongst the many secondary plans by which houses are proposed to be kept free from damp. A house wholly cellared under will rarely, if ever, be a damp house; and, although there may be a difficulty to appropriate all the apartments thus formed to useful purposes, still, in view of their healthy value, the expense of constructing them is worth going into. Those not likely to be used may be of less depth or height than the others. As apartments for the keeping of meat they are also unrivalled; and as to their utility for keeping beer, wine, &c., we need say little.

In the farmhouse proper one apartment will have to be relegated to the purposes of the dairy, although we prefer from every point of view to have this placed independently of the house; and this because it is so difficult to get a convenient place in the house in which to locate the dairy so as to be free from smells, dust, &c.; and all who know what milk is know well that it is absolutely indispensable to have it free from taints of all kinds. The consideration of the points of the dairy come more naturally under the head of farm buildings, and they will be found fully discussed in the division devoted to dairies.

For a detached dairy building we give a suggestive ground plan sketch in Fig. 136. The milk room, frequently called by the name of the "dairy," though that term embraces other apartments where the operations are on a complete scale, must be placed so as to have a north aspect. This is a *sine quâ non*, and all departures from this position must be considered as so many mistakes. The room should be of ample dimensions, so that the placing and removal of the milk can be carried on with the greatest ease. Next to the milk room is the churning room, and in which also the cheese press room is placed, should cheese be made. Opposite to this room is the washing room, in which the milk dishes are washed. It will be observed that there is no inside door to this, the object being to prevent all smells from gaining access to the milk room. When the

dishes are washed they should be ranged outside the building, under the shade or shelter of the verandah which goes round three sides, or fewer, of

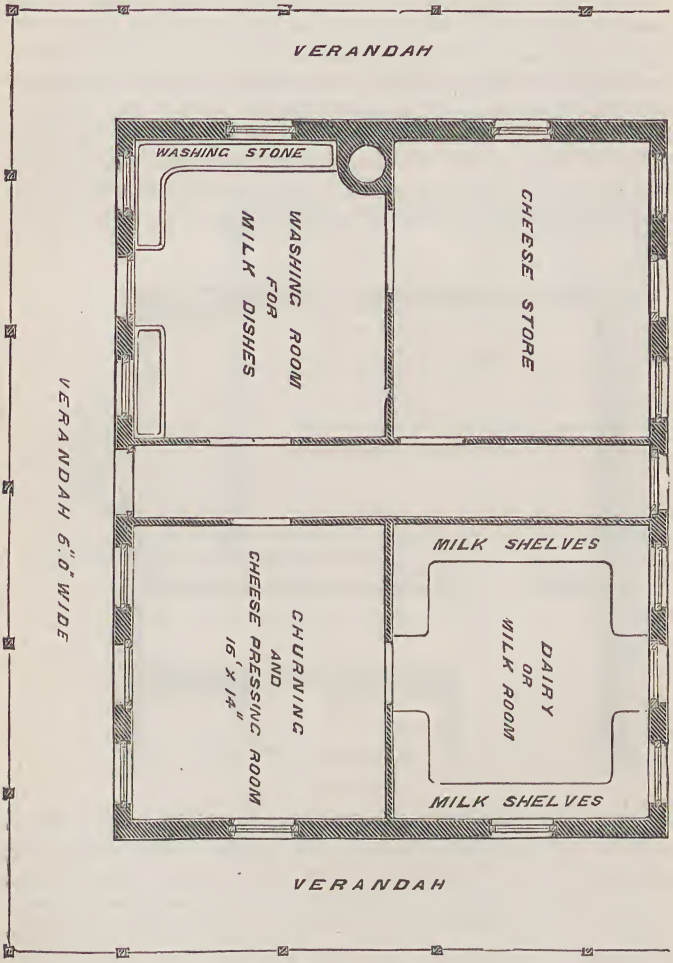


FIG. 136.

the building. The cheese store is placed opposite the milk room; and, although we have for convenience placed an inside door so as to facilitate

the carriage of the cheeses from the pressing-room, we would recommend the inside door to be done away with, and the outside alone used.

In Figs. 137 and 138 we give plans showing the dairy attached to the house, of which (in Fig. 132) we have already given the ground plan. We, in this arrangement, put the milk house in the cellar apartment, which is made under the scullery in Fig. 132. The entrance to the stairs leading to the cellar is through a door in the closet which leads off from the scullery, the stairs to cellar going under those leading up from the ground floor in Fig. 132. In Fig. 138 we give the churning room, which is on the same level as the scullery is in Fig. 132, and leads out from that apartment by a door in Fig. 138, which takes the place of the window in Fig.

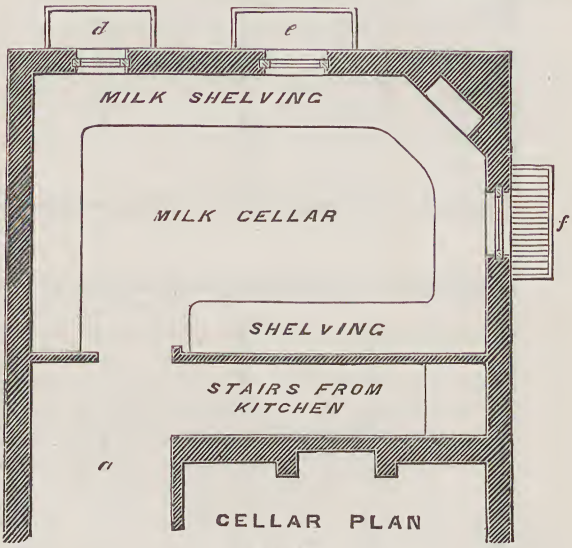


Fig. 137.

132, that being removed to *b* in Fig. 138. In the churning room, which is an off-set to the back of the house in Fig. 132, *c c* are the stairs to the cheese room above, which is of the same dimensions as in the churning-room in Fig. 138. In placing the milk room of a dairy, the great object is to have it—first, perfectly dry; second, free from the action of the sun; and third, well ventilated. In a cellar apartment the second of these essentials—and it is not the least important—is sure to be obtained. The first (freedom from damp) may also be secured pretty efficiently if the floor is made of concrete, and a layer of the same be placed outside the walls up to the ground level. By making the opening in the

ground opposite to each window (as *d e f*, Fig. 137) very wide, and sloping their outer side considerably, and by making the windows themselves open on the French or casement system, a pretty good ventilation can be secured. If the passage (as *a*, in Fig. 137) be carried right through to the front of the house, and be there provided with a window, a thorough draught will be secured through the milk house, if the windows *d* and *e* be opened. It is scarcely necessary to say that, wherever the milk room is placed, it is essentially necessary to keep from it all dust and the access of all bad smells. Thorough cleanliness, moreover, will have to be ob-

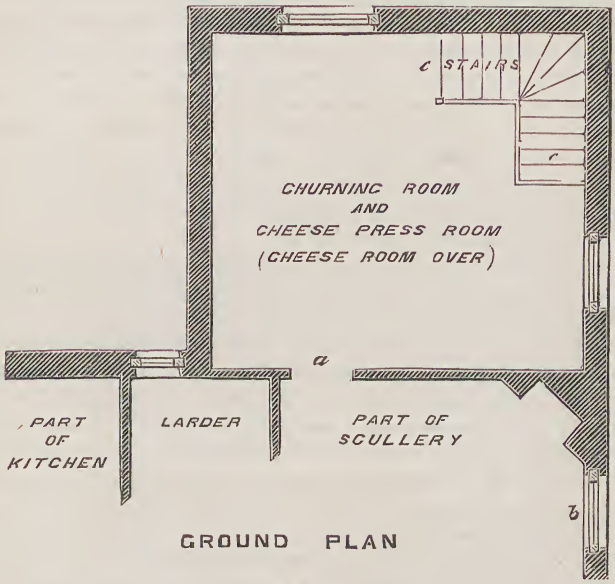


Fig. 138.

served in every part of it, both in the milk vessels themselves, the shelves on which they rest, and the floors, walls, &c.

Having glanced at the various points connected with the working parts of a house, we shall now proceed to point out as fully as we can those connected with the bed rooms. There can be no doubt that the largest amount of the time we are within doors is spent consecutively in our bed rooms, and under circumstances in which there is a very great demand made upon the arrangements by which health is secured. The sooner closets and confined bed rooms are done away with in houses the better for the health of the inmates. On this point an able medical

authority has written the following—worthy of perusal, and consideration after perusal: "We are beginning to recover from the absurd plan of cramming our beds into small closets, in order that they might be out of sight and out of the way. Architects, a few years ago, seemed to think that the public rooms could not be too large nor the bed rooms too small, provided only a dressing closet was attached. A third part of the twenty-four hours we spend motionless, and exhaling the rankest and most fœtid part of our cutaneous and pulmonary secretions in a small and confined bed room, in order that we may shiver and starve in a large room during the rest of the day we remain in the house. How often has the physician to regret the confined bed room in which his patient is placed. Often it is impossible to ventilate it by raising the window without risking the full draught of cold air on his patient. I have more than once seen the convalescent from fever cut off by pneumonia, from being exposed to the currents of cold air from a window raised a little to refresh him or to ventilate the room. Alcove beds are improper, from retaining the foul air; the bed should stand in the middle of the room, and not in a corner, and yet so as not to be in the draught from door to window or chimney."

Bed rooms should be well situated, large in point of superficial area, that is of a floor space, high in the ceiling, provided with abundance of light, well ventilated, and have their doors, windows, and fireplaces so arranged in relation to each other as that none of the floor space be lost or thrown away, or that the proper disposition of the bed with relation to the fireplace or the door and window be unattainable. As regards their situation, it is considered by many a matter of no great moment whether they be on the ground floor, or in the second floor, or upper floors. Now, we consider it essential, so far as the health of the inmates is concerned, to have the bed rooms all in the upper floor or floors. They will thus be free from the chances of damp; they will be warmer, from the warmer rooms below; and they will be quieter, being removed from those parts of the house in which work is going on—a matter of essential importance in time of sickness, and in the rooms above those on the first or ground floor devoted to working purposes, such as the kitchens; we would strongly recommend all the floors of such bed rooms to be well and properly "deafened" by lime, and hair pugging of considerable thickness resting upon fillets nailed to the joists. That is one of the advantages of fire-proof floors, that they are so well "deafened" from the very nature of their construction that they are invaluable in bed rooms in time of dangerous illness, when the life of a patient depends upon the quietness of his surroundings.

The second of the bed room requisites we have named is having abun-

dance of floor space. This is essential, if real comfort in inhabiting and using the room be considered. Now, in many even so-called "best bed rooms" space is so confined that the "essentials" as regards furniture take up nearly the whole of the space, so that but a strip on this side and on that is all that is left for moving about in. We should make the bed rooms, at least the principal ones, the best rooms in the house, and those on which the most care was expended to render them convenient and healthy. Even for the *smallest* bed room the smallest space for convenience would be one hundred feet of floor surface; this might be well distributed in a room twelve feet by eight feet six or nine feet. But this would have to be very largely increased in the case of the principal bed rooms. Where the "entertaining rooms" on the ground floor are of moderate size, the dimensions of the bed rooms on the second floor will be decided by carrying up the partitions of the ground floor rooms. This has other advantages, which will be obvious. It gives, for example, good solid partitions dividing the bed rooms, in place of those wretched hollow quarterings of battens, lath, and plastering, which are too often used for the purpose, adding as they do to the chances of fire.

The height of the ceiling of a bed room is always less than that of the entertaining rooms below, this being supposed to be demanded by the proportions to be given to the windows, which are always lower or shorter than those of the lower storey. But this lowering of the ceiling of a bed room is contrary to the laws of health; and a bed room ought to have a higher ceiling than any other room in the house. But it by no means follows that ventilation does depend upon the height of the ceiling of a bed room; a very low-ceiled room may be better ventilated than a high-ceiled one; the latter, indeed, unless other means be adopted, does simply act as a larger receiver of foul air, which, ascending to the highest parts of a room, may not be so soon felt as in a low-ceiled room, which of necessity will bring the foul air nearer and more quickly to the zone of respiration. If no other apartment be above the bed room, there is no form of ceiling better adapted to promote ventilation than the "coach house roof," or more correctly the "curbed" or "pavilion" roof—that is, one in which the sides and ends of the room are curved or inclined inwards towards a central flat space of much less surface than that of the floor. There is, moreover, we believe, no form of roof so susceptible of beautiful ornamentation: its form, indeed, is beautiful when compared with the ugly flat conventional ceiling beyond which none of our builders seem, as yet, to be able to go in the way of improvement in this department of construction. This form of roof, moreover, as we have said above, is the best possible for facilitating ventilation, if there be no apartment above

that in which it is adopted, for a very simple arrangement is all that is required to allow the foul air to escape from the interior of the room.

The bed room may be roomy enough, that is, have ample floor space in which to place the furniture, &c.; still, it may be difficult, in some cases impossible, to place that furniture in the proper way, from the improper manner in which the doors, windows, and fireplaces may be put in relation to one another. On the point now under notice, we may remark that mistakes so gross have been perpetrated that the furniture could not be properly placed at all, no tried combination of position being successful. Now, "all such absurd difficulties" as we have elsewhere remarked (in *Journal of the Bath and West of England Society*), should never be met with, and would never be, if, in planning a house, special plans on a larger scale of the bed rooms were taken and the bed space put down therein in all positions, so as to ascertain which would be the best space for it to occupy. This method of working with the plans of bed rooms—indeed, for the matter of that, all other rooms, especially the working rooms, as kitchen, dairy, &c.—on a large scale, so as to see how the doors, windows, and fireplaces will suit the practical work of every-day life, would save, as we have said, many blunders of a remarkably stupid kind; and much of the comfort, certainly much of the convenience, of a bed room depends upon the way in which the door is placed, or doors are placed with relation to the fireplace and window or windows.

With some, all that seems necessary is that the room should have a door, but whether it exercises any influence upon the convenience of the room as a place in which to sleep does not seem to have been thought of." We may take as an example the bed-room floor in Fig. 139 (of which the ground-floor plan is given in Fig. 132), and, on examining the bed room marked A, to the front, we shall find that, from the way in which the door *a* is placed, which gives entrance to the room from the landing, and also the door *b*, which gives access to the dressing room, there is no place where the bed can be properly put down without blocking up part or whole of either of the windows *c c*, or being too near the fireplace *e*. As the position of the windows could not be well altered in the room, the only way to deal with the difficulty is by altering that of the doors *a* and *b*, the first (*a*) being moved nearer to the fireplace, the second (*b*) nearer to the front wall, or the dressing room may be entered by the door *f* from the landing *g*, making it common to the two rooms A and B, or the dressing room may be changed into a "linen closet," which will possibly be the greater convenience of the two. It will be noticed as regards the bed room B that, although windows and fire place and door *h* are precisely the same as in room A, that there is more free wall space, against which to place a bed, and this because there is no door entering

the dressing closet, and thus allowing a good length of wall from *i* to *j*, and which could be lengthened with advantage by moving the door *h* farther up towards *h*. Take, again, the plan in Fig. 142 (of which the ground plan is in Fig. 133), the bed room marked A is very much in the same position as that correspondingly marked in Fig. 139; with regard to shortness of free wall space against which to place a bed, and this from the dressing room being entered from the bed room by the door *a*, this might be done away with as before, and the dressing room entered from

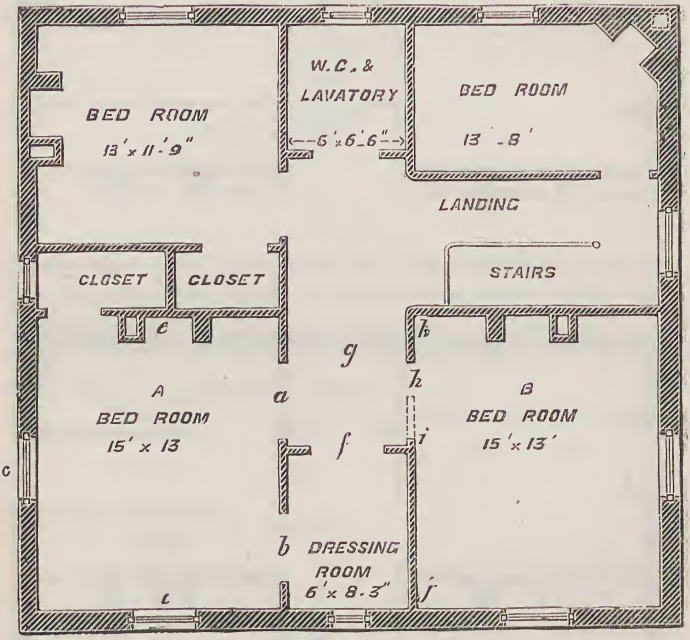


Fig. 39.

the landing. The bed room marked B has a good length of free wall space from *c* to *d*, the landing admitting of the entrance door being at *c*. The presence of two windows makes the placing of the doors with relation to them and to fireplaces a matter frequently of no small difficulty as regards the getting of free wall space for the bed and the other furniture, especially the wardrobe, as that, in the best bed rooms, is an article of great importance. The difficulty brought about by two windows to a room is well contrasted by the much greater ease of dealing with the furniture of a room in which there is only one window, as in the plans

Figs. 139 and 142, and that in Fig. 143, in which, in the first room, to the left there are two stretches of free walls, *a b*, *b c*, and even if the dressing room be entered from the bed room, by making its door as near the front wall as possible a good length of free wall (*b c*) will be obtained. In the bed room to the right, although the side *d e* is cut up by the door *f*, still

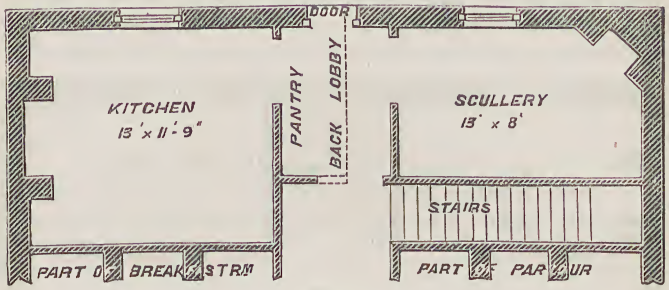


Fig. 140.

the side *d g* is left wholly free, and the spaces *f d* or *f e* will serve as those in which chair furniture, &c., can be placed. In the back bed room

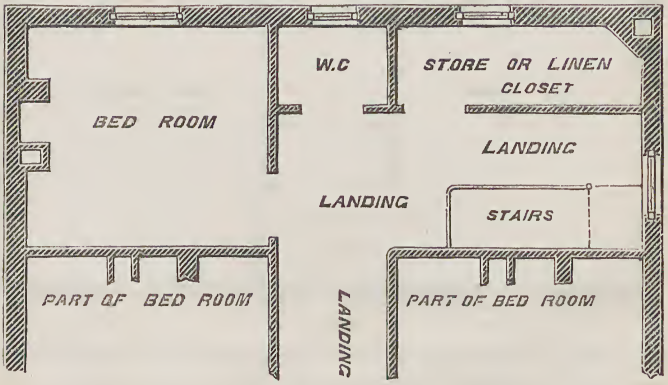


Fig. 141.

the side *h i* gives a good free space of wall for placing the bed, which will thus be equally removed from the door and the fire-place.

In the article from which we have quoted we have pointed out how much of the convenience of a house depends upon the mere hanging of the doors, as in this, as in other things, there are two ways of doing this, the right and the wrong; and where the wrong is followed it is a

perpetual annoyance, for it must be remembered that in a house the various appliances are in constant daily use, so that if so fitted up to be a trouble or a nuisance, the trouble or nuisance is one of perpetual recurrence.

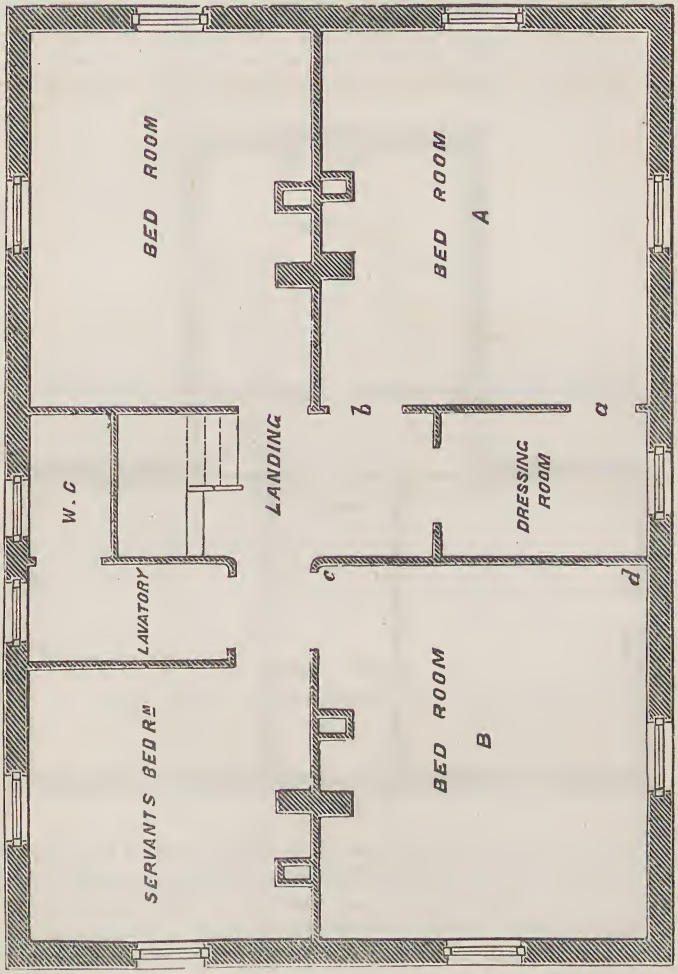


FIG. 142.

We have not space to do more than merely allude to this part of the subject of house fittings, but what we give may serve as a suggestive hint as to their importance. Thus, the door of a cupboard or pantry may be so

hung that it greatly shuts out the supply of light from a window near it, whereas, by merely reversing the door so as to open in the contrary direction, the light will be thrown into the cupboard where it is required. Again, where two doors are placed near each other, they may be so hung as to give rise to frequent awkward, and in some cases dangerous collisions; whereas, by reversing their position, the one may be opened without any chance of coming in contact with the other, which may be

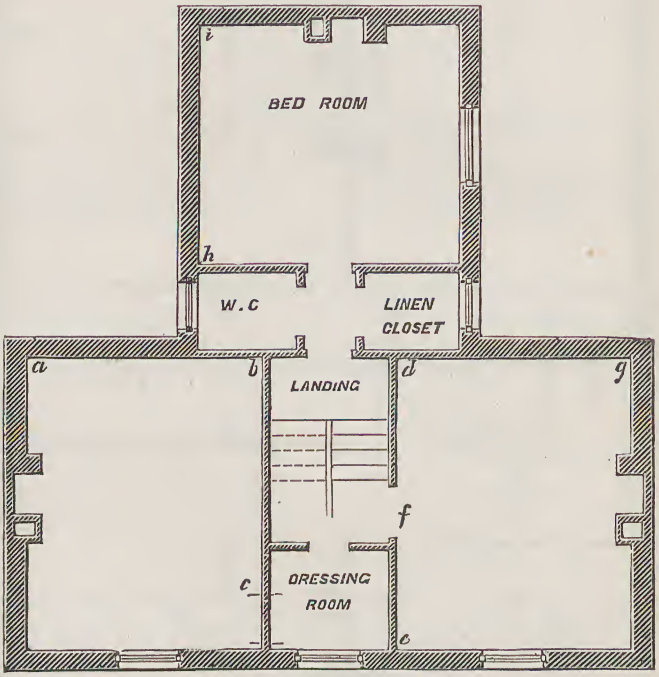


Fig. 143.

opened by another party at the same time. Again, much of the space of a small closet is lost by hanging the door so that it opens inwards in the closet, whereas, by making the door open into the larger apartment this would be avoided. Again, in bed rooms, doors are so hung sometimes, that when opened they come in contact with furniture, or cover up corners which should be left exposed ; and in narrow passages they are so hung as almost at times completely to block up the passage. These and many other awkward combinations arising from the wrong hanging of doors

will suggest themselves to our readers, if they will devote a little consideration to the subject, and show how much inconvenience and loss of time

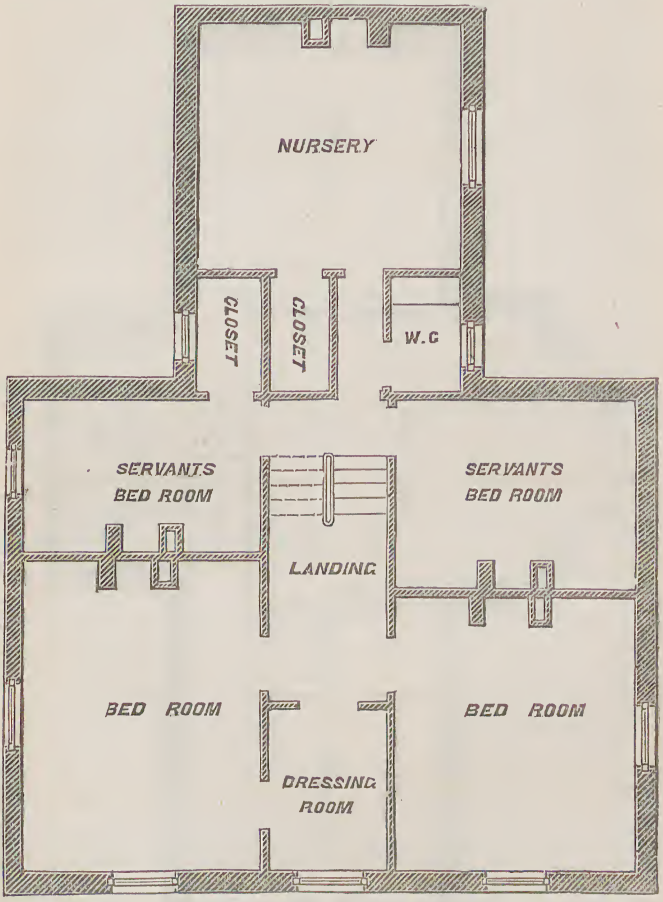


Fig. 144.

may arise from such an apparently trivial circumstance as the hanging of a door.

There are other points which it will be necessary to allude to while on the subject of arrangement and convenience of rooms; but we proceed to give the bed-room plans of those houses of which we have

given ground plans. In Fig. 139 (p. 157) we give the bed-room plan of the house of which, in Fig. 132 (p. 114), we give the ground plan. In Figs. 140

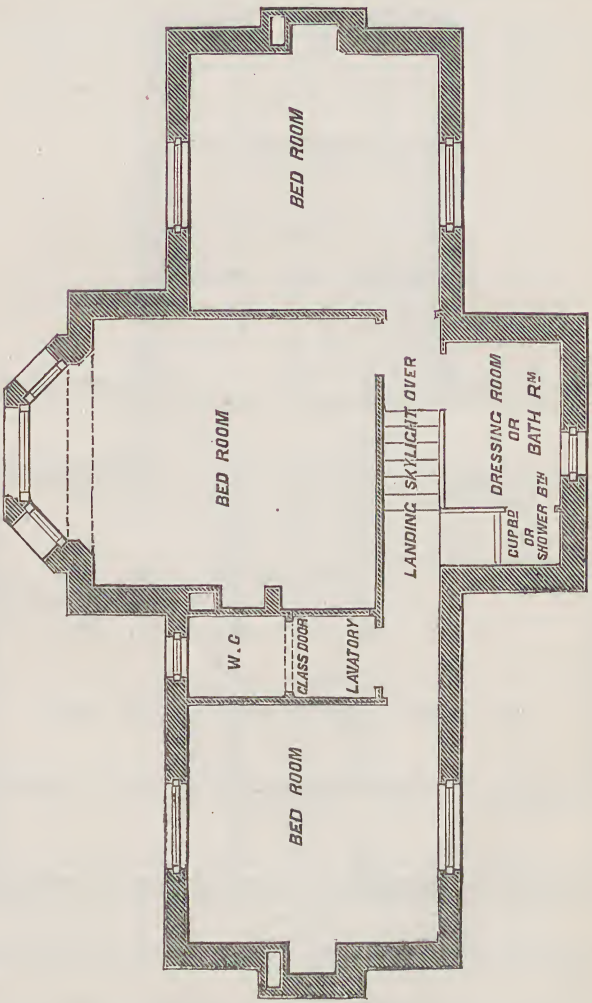


FIG. 145.

and 141 (p. 158), we give alternative plans, showing how different internal arrangements may be obtained by altering the partitions, &c. In Fig.

142 (p. 159) we give bed-room, or chamber plan of the house of which ground plan is given in Fig. 133 (p. 145); in Fig. 143 (p. 160), the bed-room plan of house in Fig. 134 (p. 146); in Fig. 144 (p. 161), the bed-room plan of house in Fig. 132 (p. 147); and in Fig. 145 the bed-room or chamber plan of which the ground plan is given in Fig. 131 (p. 141).

We now come to the question of drainage. The drainage, being hidden or concealed work when finished, shows the imperative necessity of the personal supervision of the work of drainage by a clerk of the works or a foreman not only fully acquainted with its details, but upon whose sound integrity and honesty of purpose there can be cast no doubt. Everyone at all acquainted with the "ways and doings and the little dodges" of working men, know that many of them, if left to themselves, cannot avoid the temptation to "scamp" hidden or concealed work. That "scamping" is done in drainage work to too great an extent every architect and builder can testify by the experience of his own practice. Many houses have had to be nearly gutted in their lower storeys in order to find out the causes of bad smells; and these were clear enough when the condition of the drains has been discovered—a condition showing, beyond all doubt, that the work had not been properly done, indeed, in some cases not done at all at the building of the house. You cannot be too particular in seeing how and where the drains are led and go to. When the importance of house drainage began to be recognised and to be applied practically, at first it was not applied judiciously, and some woful mistakes were made, the no less woful results of which succeeding occupiers had to suffer.

Amongst those mistakes, perhaps the worst in its evil effects was the system of taking or carrying the drains through the interior of the houses from back to front, or *vice versâ*. These house-laid drains were taken through the passages, which was bad enough, but sometimes also through the dining or other living room, which was worse. Now, if our readers will remember what we have just stated respecting "scamped" or badly done or wholly neglected work, they can form some idea of the causes of bad smells of which so many complained, and of consequent frequent sickness from which many suffered. It behoves, therefore, everyone connected with house building to make sure as to how the drains are carried and how they are constructed. Failing to do this, he may find himself saddled with considerable expenses and trouble setting matters right, which some time or other will show themselves to be wrong.

It is important to notice where the drains are led to; or, in other words, where is their terminal point? Along with other defective details of the old system there was the "cesspool." This was a species of well or sunk cistern, into which all the drainage matters were conducted. This

contrivance was bad enough, as being the cause of bad smells, and of saturating the ground around it with filthy decomposing matter, when placed at but a short distance from the house—as, say, in the back garden, green, or yard; but it may be easily conceived that when it was placed very close to the house, as quite under the kitchen and bedroom windows, or the front apartments, it was very much worse. Still worse when, as it sometimes was, placed within the house at the end of the passage. So much has been written and said about the "abominable contrivances," the cesspool, and such a crusade has been carried out against it, that our readers may suppose that they have been wholly done away with. This is not the case; they exist still, and in considerable numbers where they ought not to exist, that is in towns where there are public drains and sewers to which the sewage can be led.

Of course it will be understood that our remarks as to the "cesspool" refer only to the cases named, where their position was decidedly bad, not to the employment of it in rural districts. This employment is there often indeed generally imperative, and cannot be dispensed with, inasmuch as there is, in the greater number of cases, isolated houses in sparsely populated districts, no other terminus to which the house sewage can be led.

But while the employment of the cesspool is often forced upon the owner of the country house, there is all the difference between the cesspool properly and improperly placed or situated, and badly or well constructed. There is, in fact, nothing in the "cesspool" *per se* which forces it to be unhealthy; it is only where it is ill-placed and ill-constructed that it becomes so.

In laying out and constructing the cesspool, the following simple rules, if attended to, will make it as safe as it can be made. In the first place, let its position be as far from the house as possible. A very good and useful one will be the further extremity of the garden—good, because it will thus take it far away from the house; useful, because its position will be such as will enable its contents to be taken out from time to time to be mixed with the compost heap, the best and the quickest deodoriser, and thus utilised as manure, for which it is highly valuable. If the garden be very long, and the compost heap be placed somewhere near the centre of the garden, so that its contents can be portioned out right and left with the minimum of labour, the tank may be also placed there, and yet be far enough from the house. Much will depend upon the way the garden ground is laid out, and at what point its outbuildings are placed, for it is close to those at which the compost heap is generally placed, and this also will be a good and convenient position for the tank.

The connection of the house with the tank is made by means of drain

tubes. These should be carefully laid and well bedded in clay, the clay being itself firmly rammed down in its trench, and the inclined bed of which should be uniform from end to end, and with as great a slope or inclination as possible. Clay is now greatly objected to, as it is apt to settle unequally; and by far the best material for bedding the tubes is concrete. The drain tubes will best be laid if the ends rest in the "saddles," which can now be had at a moderate cost. The ends of the tubes when made good at the joints are covered with a cap or "cover" provided with and made to fit the saddles. This method of laying drain tubes is much better than the old one of having the tubes laid and connected together in one continuous line; for when any one part or length of tube happens to get broken or displaced and its position ascertained, which is made known generally by the saturated state of the soil near, the broken length can at once be lifted up by simply removing the caps or covers of the saddles at the ends, and a new length put in. As to the tank itself, we require here to say nothing more than that it must be designed of the best form and constructed in the best and most workman-like style possible; inasmuch as, having in the division on auxiliary buildings (see "Manure Pits") gone fully into all the details connected with these two essentials, we have simply to refer the reader to these. Before, however, concluding our remarks on this part of sanitary construction, it must be remembered that the openings of the drain tubes from the house to the tank at those points must be well "trapped."

Most important elements in the securing of efficient drainage are the "trapping" and "ventilation."

The form of trap used for sinks, or to seal the opening of drains into sewers, &c., is generally different from those used for water closets; but in many of them, and especially in one very largely used, known as the "bell trap," the height or column of water is so short that in warm weather it often, evaporates, even if used pretty frequently, till there is a mere thin film of water, which can and does offer little or no resistance to the pressure of the gases. Or, when not used for some time, as in the case of yard or outside traps, and thus neglected to have water supplied to them, the water wholly evaporates, leaving a perfectly free passage to the gases. Again, their covers are so often constructed that any obstruction passed into them prevents their closing, and thus allows the gases to pass through.

To obviate all those grave objections, some of our ablest engineers and architects have designed traps, some of which are remarkably efficient, but, being more complicated than the "average trap," are of course dearer, and, being so, are not likely to come into general use, till the public is convinced that, through sickness and disease, brought on by the

presence of foul drainage gases to their houses, they have been penny wise and pound foolish.

To get rid of the pressure of the gases of drains upon the water of the traps, the only absolute certain way is to get rid of the gases themselves ; this is the object of the ventilation of drains. The second point we have noted, which can be dismissed by a few words, so clearly simple in its principle ; this is, that the gases, as soon as they are formed, are led off by or allowed to pass away through a pipe, which is taken upwards in a vertical direction outside the wall, and terminated at some distance above the roof, and covered by a cowl or cap, to prevent the wind from blowing down the pipe. The gases escaping to the atmosphere are at once diffused therein, and are led off by it, this being greatly aided by wind or gentle breezes. We have elsewhere suggested the plan to terminate the ventilating tube in the chimney flue of the kitchen, which, being almost always in use, will create an upward current in the tube, and that at times when most required, that is, when the atmosphere outside is not favourable to ventilation in ordinary tubes. The plan would act in a double way, for the gases from the drain, mixing with the sulphurous gases from the fire, would be deodorised before passing into the air. Sulphurous acid gas is perhaps as good a deodoriser as can be had, a fact not generally known ; while the gas itself may be breathed, moderately strong, with impunity. Produced by the combustion of common brimstone, it is a capital deodoriser for cattle houses, and better than a good medicinal agent to the animals themselves, which do not suffer any inconvenience during the operation, save—and not always—a slight fit of coughing.

A few words must suffice for what we have to say on the subject of water supply—a department closely connected with drainage—to houses in suburban and rural districts beyond the reach of the town supply system. The usual sources of supply in such districts are the well and open spring, the latter running from some rocky eminence or face of hill, or bubbling clear, cool, and pure from the soil. The quality of the water is generally pure, that is, so far as freedom from noxious gases or decayed organic matter is concerned; but its hardness or softness is determined by the soil or rock through or over which it passes on its way to the surface. Some waters are very hard which pass over or lie in contact with chalk or limestone. When this is the case, the supply of water for washing purposes—and by filtration for cooking, must be had by gathering and storing up the rain water from the roofs. It is not possible to over-estimate the value of rain water for washing purposes, and, indeed, also for cooking. The rain water may be collected and stored up in cisterns, one of which should be placed a short distance below the roof in

order to supply the bed rooms; the other at a few feet above the level of the scullery, wash house, or kitchen floor, to supply those working apartments. The best cistern, however, for rain water is an underground one. This is usually an excavation lined with brickwork, set in cement, and with the best work there is a second interior lining wholly of cement. The cement generally employed is Roman, or, as it is in some places called, Terra (hence the name "Terra Cisterns"), but this should be discarded and its place taken by Portland cement, which is the best hydraulic cement now to be had.

By using this cement along with small stones, broken bricks, or any other hard substance not liable to decompose, a cistern may be made in one solid piece of concrete, which will set as hard as stone, and will, indeed, in every respect be superior to stone, even should that be of the best quality. The Portland cement concrete is now being largely used for a variety of purposes, as for the floors of sculleries, wash-houses, and even kitchens, and when well made is superior to the best stone in its lasting qualities, is more economical in first cost, and does not require skilled labour in its use.

When cisterns are underground, the great objection to them is that the water has to be pumped up out of them to the higher level where used. The trouble of doing this must be set against the superior advantages of the system as compared with that of cisterns at a higher level, and open to the atmosphere and dust, &c.

When a well has to be sunk, the object is to get it as near the house as possible, to save labour in carrying or pumping up the water. It is scarcely necessary to say that the well should not be near the cesspool, or rather the liquid manure tank; although, with the latter appliance properly constructed, there is less danger now than formerly in placing the well near it. But prevention is always better than cure after all, and it will be the wisest plan to have the two separated from each other as widely apart as is possible.

To obviate the inconveniences consequent upon pumping a supply of water from the well or other source each time it is required for culinary purposes, a small cistern may be used. This should be placed in that part of the house where there is plenty of space, well lighted and aired. The unhealthy system so often—we may say almost universally—adopted in towns of confining the water cistern in a close, dusty, dirty, ill-aired hole, should never be tolerated in the country. If this is bad, however, the other system is still more abominably worse which places the cistern quite close to and above the water closet. This arrangement should on no account be tolerated. It is surely time for some of our artificer, to become acquainted with the fact that water can be led any distance

so that it is only as in the present instance a question of a few yards more of pipe.

Having considered the subjects of drainage and of water supply, we next take up, as closely connected with the former, that of the site of the house. Of this the main—indeed, the only—feature requiring special attention is the soil. This is too generally overlooked, but there is perhaps nothing which influences in so marked a degree the health of the inhabitants of the house. This will be obvious on slight consideration, as soil that retains moisture, and from which it evaporates, either directly to the interior through the flooring or indirectly through the medium of the walls, must render the house built on it an unhealthy one. And here we would draw attention to a point which is not very well known, but with which a farmer will be well acquainted, namely, that although the field or plot on which the house is to be built is known or said to be of a clayish character, it by no means follows that all the parts of it possess this characteristic. To be certain, therefore, as to what the nature of the soil of the proposed site of the house is, it will be necessary to take special means to ascertain its nature. This will best be done by sinking trial or testing pits, sunk at various parts over the surface of intended site. These will serve more than one important end; not merely the primary one of ascertaining the character or nature of the soil, but the secondary, and not less, in another sense, important one of testing the relative states of dryness of the soil, and whether it is firm and sound, and likely to afford a foundation free from faults and fissures.

On those various points we beg to offer a few remarks. As regards the nature of the soil, the best adapted for the site of a house is gravelly, lying on a firm and deep bed of sand, although the sub-soil in such cases is often of clay. The worst is a close, retentive, adhesive clay. These may be taken as the highest and lowest points in the scale of soils for house sites. We have said that the trial or testing pits sunk over the intended site afford a good means of ascertaining its dryness. It ought to be said, however, that these are sometimes deceptive, inasmuch as they may gather or draw no water at the time they are opened, and for some time after, and yet the soil may be in reality a damp or wet one. For this opening of the pits may be coincident with a dry season—one, indeed, abnormally so; so that no true indication of the hygrometric state of the soil normally is obtained. A very useful end, however, is further secured by those test or trial pits, that is, the showing of the position or opening up of under springs. These are always fertile sources of damp in the soil of a site; being always present, evaporation is going on continually, more or less. They are often exceedingly troublesome to deal with, and especially if coming from a level much above that of

the site; and having, therefore, considerable pressure, they force themselves up to the surface. If one only is met with of this character, and the quality of the water be thoroughly good and fitted for domestic use, it will be in every way advisable so to arrange the superficies of intended site that this spring will be in the right position externally with relation to the house when that is built. A constant supply of good water is too valuable to be thrown away, and the sacrifice of some other point or points should not be grudged in order to secure it—all the more that it will be obtained at small expense as compared with that too often incurred in the sinking of a well.

Where the water of such a spring as may be laid open by the trial pits is not good, or should they be more than one, and show a tendency to rise to the surface, to test this under all weathers the pits should be left open for a considerable period—as long, indeed, as can conveniently be done. They must either be diverted by culverts or drains to some neighbouring rivulet, drainage, or other natural or artificial outlet, or built over, and concrete filling up to ground level be carefully executed. In cases where, either by the test pits or by the opening up of the trenches of the foundations, fissures or faults are found in the site, these must be carefully looked to, the best mode of dealing with them is to fill them up with concrete and carefully ram the soil round. Those fissures are not only bad, as being likely to cause irregular settlement or subsidence of the walls, causing cracks in them, and doing in short space of time comparatively infinite damage to the whole house, for a settlement in one part affects the level, and, therefore, the integrity of the structure in several parts. The fissures act also, if left unfilled, as receptacles for drainage water, which, by capillary attraction, damps the soil around, and evaporation from these sources tends to keep the house damp. From these and other considerations, which will be obvious, the immense advantages to be obtained by a thorough drainage of the whole site will be seen. This, it need scarcely be said, is the same kind of drainage as that done in field work, in which the drains are permeable, permitting the water from the surrounding soil to enter through their joints and be carried off to the proper outfall, and this, of course, wholly distinct from house drainage, where the drains are water tight, as already explained. This drainage—damp-preventing drainage, as we may call it—should be carried out in every class of soil, no matter whether it appears or is believed to be a dry one naturally, or one known to be dampish; one known to be thoroughly damp, as a close, heavy, retentive clay is sure to be, we should say ought in all cases to be carefully avoided.

The site being chosen, and the best possible made of it in order to have

it as dry, and also secure from all settlement as possible, the next point to be considered is the position of the site and its aspect. By position we mean its relation to surrounding objects; this is so important that in point of fact its consideration ought to precede the preparation of the site itself, as just described. A house may be placed in one positively unhealthy position, as where it is in close contiguity to a piece of water, or, worse still, of marshy undrained land. Water, although a picturesque addition to a landscape, and forming, in conjunction with a house, a "pretty thing to look at," is generally the cause of many complaints. Some persons are never in good health when residing near water, especially if that be stagnant, or if the movement, if it has any, is so slow that it may practically be said to be so. The external air of such a locality must be considered in itself a prolific source of many minor yet often distressing complaints, and leading not seldom to seriously dangerous sicknesses. Now, air in the immediate vicinity of water is never dry; more especially is this the case when the water has an extensive surface. A river, for the same reason, especially if it takes long bends and opens up into expanded "reaches," is not, as a rule, a good neighbour for a house.

Land, also, which has once been marshy but reclaimed, rarely offers a good position for a house; nor are low-lying fields or meadows, surrounded wholly or partially by rising grounds. That these are damp is best shown by the white mists which hang over the ground in certain seasons and in certain conditions of the atmosphere. Wherever those white mists are seen over land have nothing to do with it, so far as building a house to live in is concerned. Drainage does much to amend the state of such lands; but as drainage costs money, if they have not been drained before they are laid out for building sites, the chances are few in favour of their being drained afterwards.

Trees, although highly ornamental accessories to a house, if placed too near it, not only render it dark by excluding the sun's rays—in itself a bad thing, as sunlight is highly beneficial to health—but tends to make the air close and unwholesome, and to promote damp. All the purposes of ornamentation will be secured by having the trees at some distance from the house; and, if planted purposely, may be very artistically disposed.

Taking everything into consideration, the best site for a house where ample choice is offered is rising ground; this admits of easy and thorough drainage, of free air playing, round the house; and, if exposed to winds, a belt of trees or clump of shrubbery on the windy side will give shelter to an extent much more complete than is supposed by those who are ignorant of the subject.

A point connected with the position of the farmhouse yet to be

noticed is its relation to the farm buildings. Some writers have strongly advocated the principle that the two should form in reality part of one design. If this be advocated on the ground that, the farmhouse being closely connected with the buildings, the farmer will have such opportunities of observing the work going on that no neglect of duty on the part of the workmen will escape him, we take leave to think that it proceeds upon a false assumption. The truth is that, while it is beyond all doubt that a "master's eyes are worth a hundred pair of hands," he cannot always be exercising this great gift of eye-overlooking, and that, so long as human nature is constituted as it is, the workmen will be as much more likely to do their duty with the knowledge that the master may at any time come across them without notice, walking in from his house at a reasonable distance, as it will be should the house form part of the buildings. Moreover, we fail to see why a farmer should in this matter be placed in a worse position than other people who are engaged in any special calling. In nearly all businesses it is considered a necessity nowadays to get away for at least some portion of the day from the sights and sounds of the ordinary business operations. Nor are the sounds at least—to say nothing of the smells—arising from and steaming or welling out of the farmery quite those which are calculated to minister to the sense of still repose and healthy air which most families have a liking for. Seriously, all the necessities of the proper degree of supervision of the work of the farmery—which, be it remembered, is only part of that of the farm, as it does not include field work, which itself absorbs a large portion of the time of the farmer—will be met by having the farmhouse at a reasonable distance from the farm buildings; and that distance will actually be increased as the size of the farm increases, for, on large farms, a bailiff will be sure to be employed, whose duty it will be to give close and constant attention to the work, occasional attention only being demanded from the farmer himself in such a case.

As regards the aspect of the house, it should be so placed that the front, or that part in which the best rooms and those which are the most lived in, shall face the south-east; this aspect gives a greater amount of sunlight, during a greater number of days in the year than any other. Some woeful mistakes are made as to the aspect of a house; thus, in order to have the frontage towards a road which happens to be on the north side of the site, the front and best part of the house is made to look to the north or north-east. This gives the principal rooms a perpetually gloomy aspect, for no rays of the "blessed sun" can ever enter there, while at the same time it exposes them to the full force of the worst winds which blow in this country. A house should be somewhat near a road, for reasons of convenience which are obvious, but it is a

mistake to place it too near, for roads are in dry weather dusty, and dust has a surprising facility for finding an entrance into the interior of houses, where it is not merely a cause of dirt and discomfort, but of sickness or ill-health if the lungs are too frequently made to inhale it. Dust, moreover, helps to waste furniture and dresses wonderfully quickly, and involves no small labour on the part of the domestics in getting rid of it, and labour is time, and time money; so that in one sense it may be called "gold dust," as a wit might dub it. Too near a contiguity to a road destroys the sense of seclusion and privacy which most persons like.

Having thus run rapidly through the chief points connected with the site of a house, its soil, its position and aspect, we are now prepared to conclude the present department of our papers by glancing as briefly at a few constructional details which exercise an influence, more or less marked, on the healthiness of the house.

We have already referred to the evils arising from damp, this being produced by a variety of causes. A fertile source of it is placing the house so that the floor level is quite close to, or very little above—and, what is a thousand times worse, below—that of the ground. Now, however carefully the soil of a site may be drained, the fact remains that the ground or surface soil will be often in a very damp condition; or its temperature so low that damp, in certain conditions of the air and during times of much rain, is easily created. The practice, therefore, above alluded to, of having the floors of the lower rooms of a house or villa almost upon the ground is, of necessity, a bad one, and soon shows itself to be so in damp passages and lobby floors, and in decaying timber in floors of living rooms. The level of the floor, therefore, should be some three steps at least higher than that of surrounding ground level. This brings advantages other than a dry floor; it enables a free circulation of air amongst the timber of the flooring, and the vacant space thus left beneath it tends greatly to equalise the temperature, and therefore to keep the floor warmer. This may appear to some very doubtful, to whom we should say, test the difference between the two modes of forming the lower floors, and then decide as to the correctness or otherwise of our statements.

The soil surface below the flooring of every house should be thoroughly cleaned before the flooring be permanently finished; and the value of this suggestion can only be fully appreciated by those who know practically the condition in which the floors of houses are left by workmen. A good plan to secure dryness in the timbers is to fill the space partly with clean smithy clinkers, or to cover the surface of the soil with a 2in. layer of concrete. This latter will make the floor also damp and rat proof.

Having briefly discussed, or, rather, merely glanced at some of the principal or leading points connected with what may be called the constructional departments of the farmhouse, it remains for us to take up and treat of those connected with its interior arrangements or conveniences. To do full justice to these, not only would a large space for the descriptive matter be required, but this would demand for its full elucidation a number of plans. Neither of these can be given here, as the space at command is well nigh exhausted. Fortunately, so far as the plans are concerned, those which we have already given, although not all strictly designed for farmhouses, are mostly so, and all have been arranged with a view to the requirements of rural houses, so that by modifications more or less complete, even those may be made to suit the necessities of the farmhouse proper. As regards the descriptive matter, we must be content to put this into the form of "hints," somewhat of the briefest; but, brief as they will be, we trust they will in some degree be of practical usefulness as suggestions which will lead to others, so that by no great exercise of careful study, the subject may be rendered by the reader somewhat complete.

As to the accommodation which the farmhouse should afford, that will depend upon circumstances; but we shall take for illustration a farmhouse of the first class, adapted for the residence either of a farmer who has a very large farm and abundance of capital to work it with, and spare cash to live well upon, or who farms moderately, but being a man of means, requires a good establishment. The accommodation, then, may be divided into two classes—first, the living apartments, as they may be called, and second, the minor adjuncts attached to or connected with these, and which may be called conveniences. These last, again, may be classed under one or two divisions—first, those which minister specially to health and comfort, and second, those which aid the easy and economical (economy, as regards time as well as money, both being considered essential in a well ordered house) working of the establishment.

Of the interior conveniences which minister to the health and comfort of the occupiers of the house, not the least important is the water closet. From false notions of delicacy it is generally placed in some inconvenient and, what is worse, some confined out-of-the-way space, in place of being easily and conveniently got at, and in a large, airy, and well-lighted room. Undoubtedly, the best and healthiest position for it is out of the house, but the requirements, the made necessities, or the prejudices perhaps of the modern way of living, insist on having it inside the house, and all arguments, as far as regards convenience is concerned, are in favour of this system—convenience specially marked in the case

of the invalid or the convalescent, for whom, indeed, this position is a necessity. It is different, however, with those points bearing upon the health view of the case.

That a combination of the exterior or open air, and interior or house system, or a compromise between the demands of the two, could be made, and that with comparative ease in large houses, admits of no doubt; there may be some where small houses are concerned.

Where closets are placed within the house they should be as much isolated as possible from living or sleeping apartments, and always be placed against an outside wall, or altogether outside the wall in a projecting oriel-like building, or in one of several other ways which will at once suggest themselves to the clever and experienced architect, the chief points to be secured being the ceiling quite outside, so that the foul air shall be at once led off to the atmosphere; and, secondly, cross lights or windows not only to give ample light, but to aid the ventilation. They should be made very much more roomy than they usually are, and be well lighted and ventilated, their position next the outer wall admitting of this being pretty well done. In large farmhouses each floor or storey should have its own closet, and, although the closets on the various floors will for obvious reasons be placed in line above one another, advantage ought not to be taken of this to save piping by making all the closet pipes run into one leading soil pipe. The reasons for this will be apparent. Let each closet have its own separate pipe well and carefully trapped. This may be objected to as both expensive and difficult to be carried out, and as giving an ugly collection of pipes on the outside wall. But there is no necessity for the pipes being shown on the outside wall. Space should be made behind or at the side of the closet for a shaft reaching from top to bottom of the house, the pipes being carried down this shaft. They will be easily inspected, and, what is of great importance, well protected from the frost. The objection to the shaft at the back of the closet where that is inside the house walls, is that back light is lost. But the architect will be able to arrange a design or plan by which all the points we have named may be secured in a way at once effective and as econonomical as possible.

The bath room is now an indispensable convenience in nearly every house of any pretentions to completeness of plan. Its situation or position is, however, as a rule, but little studied with reference to the laws of sanitary science. Too frequently are the bath, the lavatory, and the water closet placed together in the same room. The idea which produces this conjunction or contiguity of such appliances is by no means the right one; there is a manifest incongruity in the arrangement. The bath room should be an isolated apartment, large and roomy, well lighted,

and specially well ventilated. In the case of the "invalid's room," the bath room should be near, and yet be isolated from it. Some little ingenuity in planning will be required to meet these, as well as in connection with the other conveniences we have described; but there ought to be no difficulty.

Having thus briefly given some hints as to the conveniences of the farmhouse, we now come to notice those which are connected with the living and working parts. These may be summed up in a sentence or two. First: As regards the extent of the accommodation in respect to entertaining rooms and bed rooms, that must be dependent upon circumstances. We note here only that there should be a surplus rather than a deficient supply of bed rooms to meet the claims of country and chance visitors always turning up. But as regards the working accommodation, that ought to be given uniformly in all farm houses, whatever be the extent of their accommodation otherwise. This will comprise cellar apartments, these not only being valuable for keeping provisions well aired, but also as tending greatly to the keeping of the house free from damp. Next comes the apartments on the ground floor, of which the chief is the kitchen, with its back kitchen and pantry. After this come the dairy rooms, which may either be placed in an off outbuilding at the north back of the house, or north-east, or, if under the general roof, in connection with the kitchen, the milk room being farthest from this, the boiling and watering house being the nearest. The cellar will afford an excellent milk room, or even the space for the whole of the dairy rooms; and on the second floor, along with the churning and cheese making rooms, should be the cheese store. A laundry or wash-house should be provided to a very large farmhouse, in addition to the back kitchen and scullery, which will serve in smaller houses for washing in. A detached laundry will be better than one attached to the house. Accommodation should be provided for fuel and wood, and for the storing up of the ashes, &c. A small apartment for smoking hams, beef, &c., will be a useful addition to the back premises; nor will an ice house be found to be less so.

Abundance of store, closet, and pantry accommodation should be provided throughout the house, than which nothing adds more to the convenient working and economy of the time of its working inmates. Shelving, too, and meat hooks should be carefully looked after and provided; and, as an essential part of the accommodation for the servants, let their bedrooms be good, both as regards position, size, and fitting up, and never on the ground floor any more than other bed rooms. Servants' bed rooms, as a rule, are a disgrace to our householders.

With reference to the entertaining rooms, as dining, drawing room,

&c., it may be noted that while, as a rule, abundance of floor space is essential to comfort, as well as to the ease with which the necessary service is to be carried on, this may be overdone; and the rooms present, in their too ample dimensions, the characteristics of the saloon or *salle-à-manger* of the Continental hotels. Rooms of this kind are never comfortable; at least, they give the impression that the snugness and compactness, which is the essential feature of our English living rooms, is lacking, and this is pretty nearly equivalent to the fact that the rooms are really uncomfortable. Moreover, however appropriate such large and spacious saloon-like chambers may be in the town mansions of the wealthy, who keep, if they do not entertain—there is a distinction with a difference here worthy of note—much company, they are scarcely appropriate to the calling of the country farmer or gentleman farmer, unless, indeed he be very wealthy, and does not belong to the category of those who "live to farm, and farm to live," as it has been epigrammatically put. The farmhouse should, in its interior arrangements give, as the pre-eminent characteristic of it, a thorough air of comfortable ease and unpretentious appearance. Although the dining-room and drawing-room should, as well in their size, fittings and adornment, be such as will be in perfect keeping with the calling of the farmer, we should add to the well-appointed farm-house the snug comfort of the lesser breakfast-room or parlour, in which much of that delightful family freedom and unbending from the formal conventionalities of the drawing and dining-room may be relieved. And to these should, as a matter of course, be added the "office" or library of the master, in which he can have the necessary privacy to look over accounts and papers, or receive visitors on business. As to the bedrooms, so far as size is concerned, we have only one remark—let them be large and airy. No rooms in the house should be more attended to in these respects, as in none is so much time spent as in them, and in none, therefore, is health more to be considered. To those accustomed to bedrooms of this kind, no contrast can be more powerful than that afforded by them and those of the small ship cabin species, designed and arrayed as if space were far too valuable for either health and comfort to be considered.

Coming to the working apartments, kitchen, scullery, &c., we would remark, with regard to the first-named of these, that the dimensions should be ample, so as to give abundance of space for the work to be done in it. Nothing tries the temper and wastes the time of servants so much as lack of space to work in, more especially if to this be added the other discomfort arising from want of cupboard and pantry conveniences. The kitchen windows should be well considered both in regard to size and position; so that not only abundance of light be secured, but

that it shall be given to those parts where it is most required; of these the fire-place, where all the cooking is done, is obviously the most important. The light in this is often so badly adjusted that the work cannot be carried on properly. The conveniences of shelving, hooks, &c., should be well considered also, and so placed that they will not only be convenient as regards position, but as regards height, that they will be easily reached. The kitchen and its convenient adjuncts, the scullery or back kitchen, and the wash-house, if there be one, should all be on the same level, and that ought to be the level of the dining-room. Steps should always be avoided, not merely because they are fertile sources of accidents and dangerous, as well as expensive sometimes, but because they are invariably the cause of much loss of time; they are always evidences of bad or careless planning.

In stairs, while on the subject of steps, the rise should be moderate, 7½in., the usual rise is, perhaps, as generally easy as any which can be adopted. The shape or surface of those parts of the stairs technically known as the "half space," and the "landing," should be rectangular, never triangular, or "winders," as they are known in the trade; those are always inconvenient, and indeed dangerous, and can easily be avoided by a little care in the planning.

Whatever the external style should be, it should be wholly free from all the affectation too often seen. Those "stuck on" additions, generally used on a "pretty-looking villa" or suburban "cottage ornée," made to sell, are quite out of place and keeping in and round the farmhouse, of which work to be done in and about it is the leading feature. Ornament, if considered as ornament, is not to be despised as an intellectually healthy addition to our houses external as well as internal, but it should be aimed at rather by the addition of "rustic" or rural objects, such as plants and flowers of various kinds, trained by the hand and guided by the eye of taste, rather than by the mere "sticking on" of manufactured ornaments so-called, which are used generally without any taste at all. By the judicious use of "rustic adornments," even a house of the plainest possible outline, and wholly destitute of all that is generally designated a architectural effects can be made not merely to look pleasing to the eye, but "beautiful exceedingly." And by the extra work of the projecting porch, verandah, and bay window, not only can additional localities be obtained for the rustic adornments, but the plainness of outline be greatly relieved, and an architectural character be given to the house.

As regards the "style of architecture," as the phrase goes, in which the house is, or should be built, what can we say but that "Who can decide where doctors (architects) disagree?" It is exceedingly difficult to please everyone, and he who attempts it will find himself in the position of the

man in the fable. Some advocate the Italian, some the Gothic, some the Classic, and some a style which they fondly hope is to be the new style of the day; and in the midst of all these conflicting opinions the party who is about to build a house has a difficulty to decide as to what style his is to be. If money is no object, and a handsome house desired, which in its general effect will please the owner, we should recommend him to confine his choice to two styles—the Italian and the domestic Gothic, or Italian Gothic. The Italian is characterised by its roofs, which are not high pitched—that is, are comparatively flat, or do not slope so much—and which are generally made to extend beyond the walls considerably, and are there ornamented with projecting brackets or cantalevers. The windows are often furnished with balconies, and the doors are recessed. The porch, or verandah, forms frequently a marked feature of the style, and projecting windows in one or other of the forms known as the bay and the bow may be added with effect. Generally, however, flatness is often made to be, although it is not, a necessity of the style. In that striking class of the style known as "Venetian," some lovely effects of light and shade are produced by the deeply-recessed windows and doors, and those difficult to be dealt with, the chimney accessories, are generally successfully overcome. The plan of the house in the Italian style is generally more regular, and less marked by off-sets and projections than the Gothic.

This latter style has for its decided effect irregularity in plan, high pitched roofs, often broken up into lesser, or what may be called minor roofs, being those over dormer windows, or those which project from the angle or incline of the roof, yet having vertical fronts. The Gothic gables are also characterised by their ornamented fronts, known as barge boards, and the windows and doors not so deeply recessed in as in some forms of the Italian, but are marked by their peculiar dressings.

For the style of the true farmhouse some candidly prefer the square-planned outline, giving some simple architectural effect by a verandah or porch to the front door, with a few brackets to the windows. The square house may also be much improved in appearance by giving the door a slight projecting off-set, and carrying this up to the second storey. A bay window in the ground floor and dormer windows in the roof will add also to the general picturesque effect of the style; and the roof itself may be finished with a flat or pavilion surface, which, if surrounded by a neat ornamental railing, with pinnacles at the corner, will still further take off from the baldness of the square outline, to which so many object, and give it that degree of irregularity which so many nowadays think so well of. On this same subject of irregularity in

design, the following remarks, although made with special reference to the decoration of grounds about a house, bear so closely upon the subject under consideration that they will be suggestively useful here: "It is not an unfrequent error to suppose that the modern style consists merely in irregularity. But without arrangement this is not taste; confusion is not the beautiful in Nature. The perfection of art consists in producing a pleasing effect, while the art which produced it is concealed from the eye of the spectator."

On the subject of style a volume might easily be written, and we would "just end off where we began," by plainly confessing that it is a matter in which each must please himself. Houses were "made to live in, not to look at," and if the architect should succeed in designing a plan which, when worked out, will come up to this standard, then we venture to say that his client, and specially his wife and "they of his household," will be so pleased that they will very readily forgive any little mistake made in the artistic department. It is surprising how rapidly defects in external design are forgot, while those in internal planning never are, and this for the simple reason that these are coming up every day—perhaps in the course of the day coming up dozens of times to try the housewife's temper and cause her to lose her time.

The Bailiff's and Overseer's House.—Little need be said on this, as it may, according to circumstances, in point of accommodation, fitting up, and external style, be looked upon as a lesser farmhouse or a larger and very superior labourer's cottage. Its position should, of course, be near the farm steading, but not too near. The necessary supervision over the work to be done can be given as well from a house situated at a moderate distance from it as when placed so near as some recommend; then the contiguity to the cattle houses, &c., positively constitutes a nuisance to the inmates. It is not the sense of his being near to their place of work which will or does influence the labourers to keep honestly to it, it is the uncertainty as to when and where the bailiff will "turn up" and an active bailiff is ever on the move, affording a literal exposition of the proverb already quoted, that a "master's eyes are worth a hundred pair of hands." The labourer's cottage is treated of in the following section.

Labourers' Cottages.

So much has been written on this subject that it is a hard task for anyone to write something new concerning its many-sided features. And yet this something new is not at all required, for we cannot ignore the

fact that the subject—old though it be, and hackneyed as its treatment may by some be considered—is one of such vast importance to the well-being of the community that its requirements cannot be too frequently nor too boldly put before the public. For if these were deemed of importance in the times which are past, when the labourer—we here specially allude to the farm labourer—was "nobody," who had "no social position, no vote, no nothing," what must be its importance now, when, right or wrong in the assertion of his rights and in his method of asserting them, he has at all events discovered, or by clever folks it has been discovered for him, that he has rights, and that he shall assert them? In view of the very different aspect which the question of the social condition of the labourer now presents, and which, for some time to come at least, it is likely to present, that of his cottage assumes a very different phase, and one which demands immediate attention. It will be well therefore if we glance briefly at the leading points of the whole subject, premising that much of what we have already said in previous papers in a general way on the subject of rural architecture will apply more or less specially to certain points concerned with the management of the cottage of the labourer; as for example, its site, drainage, outline or form, &c., and in its economical construction. And here it will be well to notice that much of this economy in construction depends not merely in doing what is to be done in the best and cheapest way, but in fairly considering what is necessary to be done. For it is a fact that cottages are planned and built having accommodation which is not required, and the giving of which necessarily involves outlay which might be spared if due consideration is given to what is really wanted. And what this is, is best known to those who are to live in them; yet we venture to say that where a cottage was about to be built—or, what was worse, a series of cottages—in not one case out of a hundred was the party, or family, or labourers who were to inhabit them asked what it was they liked, what disliked; what they required, and what they did not require. Surely a common-sense mode of procedure, and one calculated in reality to save both time and money. As the result of the neglect of this mode of proceeding, a large number of cottages have been built throughout the country with accommodation in excess of that which was required by those who use them; and, further, with a class or kind of accommodation and fitting up which either the well-founded experience or the ill-founded prejudice of the cottagers would not allow them to use, or convinced them were not required. In either case the practical result was the same—useless expenditure.

In deciding to build cottages for the labourer the first thing to do is to learn what he requires. In some cases a certain number of apartments

will be necessary; in other cases these will not be so. Let the empirical rule, which has obtained credence and favour in so many districts, that a certain number of bed rooms *shall* be given to every cottage, no matter in what locality it be situated, or no matter for whom it may be intended, be well looked into, so that it be ascertained beyond a doubt whether it is applicable in the special case or not. Such a hap-hazard rule has met unfortunately with most hap-hazard results, and many a cottage now stands a witness to its absurdity in having rooms never occupied. The same may be said of the "parlour" as a living room extra. In the large majority of cases this extra room is never used; it is either locked up and made a lumber room, or, if the cottager's wife be house-proud, she may fit it up as a show place, only to be entered upon grand and solemn occasions. It seems to be scarcely even thought of that the working man has *his* notions of house comfort, what a house should be, what it should contain, and what he would like in it. The practical result of all this has been that a set of unpractical rules has been established, which cause the cottages to be so much dearer than they should be that, as stated above, those who have the means and the will to do have been deterred from building.

There are cases in which small cottages, with the minimum of accommodation, would be much more useful than cottages with the maximum accommodation as per the empirical rule. Even as regards separate bed rooms, it is notorious that a married couple of farm labourers without children in some districts will prefer to have a bed put up in the living room or kitchen, and sleep there rather than in the separate bed room, however good that may be. The working classes love warmth, and to obtain this they will set at defiance all the rules which "finer folk" have written down for their guidance. It is only where sons and daughters or other relatives, and lodgers, come into existence, that the necessity of having separate bed rooms for the sexes also becomes a necessity.

As to the living room, as it is more generally termed, or kitchen, as it actually is, an essential connected with it is that it be warm. Hence the necessity of having the outside entrance to it guarded as much as possible from the access of "cold and wintry blasts." This is best done by having a "porch." This may be either external to the house, as in Fig. 146, or internal, as in Fig. 147. Fig. 146 is, however, the "porch" proper; Fig. 147 is a "lobby" on a small scale. This convenience goes a long way in making the kitchen or living room comfortable; but, as the French say, there "are faggots and faggots," so there are porches and porches—those which give the maximum and those which give the minimum of shelter and warmth. Thus it is obvious, if the door of the porch, as

a, Fig. 146, and door *b*, giving entrance to the living room, of which part is at *c c*, be exactly opposite to each other, the "biting blast" will find easier access to the living room (*c c*) than if the door of the porch be at *d d*. And it will show an attention to those little things which add materially to the comfort of the cottages if the direction in which the wind usually blows be observed, and the side of the porch on which the door be made be placed in the opposite direction. The side, or part of the porch opposite the door, as *e*, Fig. 146, will give space for a small window, by which the porch may be lighted when the door (*d d*) is closed; and this side (*e*) of the porch may be fitted up with shelving, which will be found very useful. We have known, indeed, this part of the side of a porch fitted up with a slop-stone, thus forming the porch into a small scullery. But unless extreme tidiness be the characteristic of the housewife, it is apt to degenerate into an

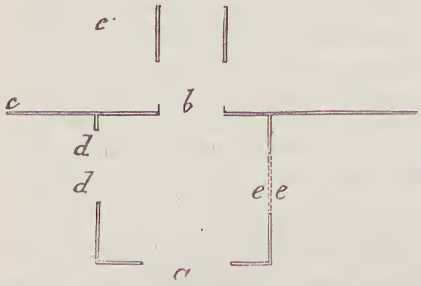


Fig. 146.

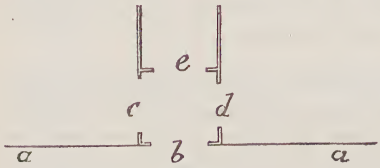


Fig. 147.

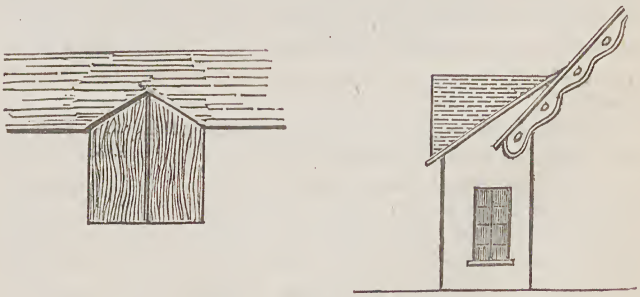


Fig. 148.

untidy place. We have said that Fig. 146 represents the cottage porch proper, which, while it gives several advantages, gives also some disadvantages, which must not be lost sight of. In the first place, it

necessitates a roof, and, as we have said more than once, a roof is an expensive part of a structure; and that of a porch, for its size, is particularly so, as the junction of its lines with the roof proper of the cottage forms parts which will be difficult to keep in repair—if not difficult, expensive. This is illustrated in Fig. 148. The internal porch, shown in Fig. 147, obviates all difficulties as regards proper lines. In this *a a* is the front or outer wall, for it does not follow that the porch should be to the front—it may be to the end wall, in which the entrance door, *b*, is made; side doors, *c* and *d*, may go off right and left to rooms, as the living room and a bed room; while a third door (as *e*) may enter to a closet (which must be dark, or, if lighted, lighted by a borrowed light, or skylight if the cottage be single storied), or this door may give entrance to the stairs, if the cottage happens to be a two-storied one.

It is impossible to give anything but a glance, and that a brief one, at the leading features of the labourer's cottage. And, fortunately for the exigencies of space, many of the details which have been given in connection with farm buildings and the farm house apply, with modifications of greater or less importance, to the construction, as also in some degree to the arrangement, of cottages.

As regards constructural features, taking the questions of site, drainage, and sewage, &c., the details of these are very similar indeed to those given under the head of the Farm House. As regards the position or locality of the cottage, this will depend in great measure upon circumstances. Rural cottages for labourers may be divided into two classes with reference to this point of position or locality: first, those situated in hamlets or small villages; second, those more or less isolated on the separate farms or portions of an estate. In the first of these the labourer walks to and from the farm, which may be remote from the village; in the second he lives close to it. With the advantages or disadvantages of one plan over the other we have nothing to do here, our present business being architecture only. As to locality of the village cottage, we have no remark to offer, this being a point altogether decided by the party who builds it, the labourer being in no sense considered as necessary to be consulted in the matter: it is simply with him Hobson's choice—that or none. Too often, however, the same may be said of the labourer whose cottage is a truly farm cottage. The labourer himself would gain much, while, as a rule, his landlord or employer would gain more, if he were consulted not only on this point, but on that of the arrangement or internal conveniences, and also the external ones of his cottage home—if not as regards locality, at least assuredly as regards what are called conveniences, as pigstyes, &c.; for he who has to live in the cottage knows better than anyone else what

tends to secure his comfort and enables him to live most economically. When the locality is a term definite and precise, the position of a cottage is one possessed of two meanings: it may include or mean only locality; but it may include or refer to the actual placing of the cottage on the ground, the locality of which has already been decided; thus it may be so placed on that ground that the living rooms look to and face the worst, or, on the contrary, the best, possible exposure and aspect. What we have said on locality and aspect on the farm house applies just as strictly to the farm cottage: to that we therefore refer the reader. The labourer has a right to have his house as well placed as the farmer, nor will anything be lost by the latter if he accedes the right pleasantly and cheerfully.

Coming now to the important point of arrangement, or what is commonly called the plan of the cottage, so many considerations have to be taken into account, so much to be consulted, that we can at the best give but the baldest outline, and that of the general features only; much of what has been stated in the section on improvement of old cottages will be applicable to this as well as other departments in the series. In this department of the accommodation or plan of the house, we have at the outset to draw attention to an important point connected with it. One great mistake hitherto made has been arranging the cottages of too uniform a character as regards the amount of accommodation; for there are obviously families with no children, and to give them a cottage with the maximum of accommodation would be as absurd as the forcing of a family with a larger number of children to live in a single room cottage. With large and small families in the community of labourers there must be large and small cottages to meet varying necessities. Besides, to put down a number of cottages, all of them on the same plan, and that involving the maximum of accommodation, is simply throwing away money, when cases turn up in which the family is on the minimum scale of numbers. Moreover, it is an injustice to the labourer himself if the loss to the landlord here noted is attempted to be avoided by charging to the small family the same rent as is done to the large, for the man with the small or no family is forced to take and pay for accommodation the major portion of which is really of no use to him. It is well to consider also whether the additional expense for a sitting-room or parlour should be incurred; and if the question were put to the labourer as to whether he required it or not, we have no hesitation in saying that the reply would be almost invariably in the negative. The truth is, the working classes prefer to live in the kitchen. For, as the work is done, and a fire almost invariably used in it, it is not only the most comfortable room in the house, but

the habit or desire of being all together accords much more with the feeling of the working classes than that of part of the family sitting in one room while others are working in another. To such an extent, indeed, is this habit carried out, that frequently in the southern part of the kingdom the heads of the house prefer sleeping in it. In the northern part, where a box, inclosed, or wall beds are used, one at least is sure to be in the living room. It would be a good plan, indeed, were this habit of consulting the labourer himself as to what he really wished to have in his cottage was extended to departments other than those we have named. If so, not seldom would the landlord find that, as regards not merely accommodation, but fittings of the cottage, much expense could be saved; for, as a rule, they do not like or care to have so many of what one of the class designated the "fal-de-lal" kinds of fitting.

But while we are strong advocates for the adoption of the principle of the accommodation of a cottage varying according to the family who are to occupy it, we are no less advocates for the having a certain class of accommodation in every cottage, no matter whether that be of the smallest amount. This accommodation is that connected with the working part of the house chiefly—for example, the scullery; to this should be added a pantry or larder, together with odds and ends of cupboards and shelving. Every cottage, no matter how small, has its work to be done, and, although varying in degree, it is the same in kind through all sizes of cottages. Those conveniences we have named in the interior of the cottage are absolutely essential to the doing of that work well, quickly, and comfortably. Under the section where we treat of improvement of old cottages some remarks will be found bearing upon them.

Of conveniences exterior to the cottage, and which everyone, no matter what its size be, should have, is either a water-closet or privy, and the ashpit, and coal or fuel places. The question has been much discussed as to whether the privy should not be placed inside the house, and transformed from the open old-fashioned convenience to the modern water-closet. We have no hesitation in saying that this plan is by no means an improvement. On the contrary, we distinctly maintain that for that class of property it would create a great nuisance—and this not only on account of certain obvious reasons, but because the class of people living in cottages do not pay the attention requisite to keep the water-closet in order; but use it often as a receptacle for solid refuse, as ashes, &c. We never knew of an instance of an interior water-closet in a cottage being anything else but a nuisance in every way. Further, the matter is rendered worse from the necessary absence

of the convenience of proper drainage, necessitating the use of the cesspool, which is too often put in dangerous contiguity to the house. All the necessities of the case are fully and most healthily met by having the old-fashioned open privy placed exterior to, and at a reasonable distance from, the house, and if ashes are put into it occasionally all unpleasant smells will be avoided, and a good manure for the garden will be obtained; or material for the compost heap. If the cottager would take the trouble to have a box of dried earth, a portion of which sprinkled over the surface as occasion required, he will be provided with one of the best deodorisers known; and, if a handy or clever fellow, he might devise and put up at a very small cost some simple self-acting apparatus *à la mode*. The great evil of the open privy in property of this description is the habit which the cottagers have of throwing soiled water into it. This makes too much liquid, destroys the deodorising power of the ashes or earth, and does away with all the advantages of the privy and ashpit combined, which, by keeping the whole as dry as possible, would be obtained. The above involves the necessity to have the ashpit covered at the top, but not at the sides, to prevent the rain water from mixing with the ashes. If a small cesspool is made in the garden to which the sullied water could be led by a pipe, the conveniences in this department would be complete. Failing the cesspool, and having, as we should advise every cottager to have, a row or rows of currant trees, a simple open gutter made in the soil would conduct the sullied water to their roots, or it might be carried to and fro in a bucket and thrown where the trees grow. No doubt this would be a trouble, but this objection might be made to every piece of work done, but in this case it would be repaid to an extent that only those who have tried or seen the plan tried have any conception of, so abundant is the crop, especially in the case of black currants, which, as the saying is, take no end of sewage water. We have known a family of two kept for a large portion of the summer months on the produce of a few currant trees so treated. All this may be considered by some outside our subject, but it is not so, being closely and intimately connected with it, such having a greater practical importance than many discussed in connection with the cottage question. In many districts the privy—as befits—and coal place are inclosed within a small back yard. We approve of this plan, as it is not only convenient for carrying on many operations, but it admits the cottagers to secure that privacy which we deem essential in all families.

Another of the conveniences exterior to the house is the piggery. This is best placed at the farthest end of the garden—with which we presume every cottage is provided. Some like a poultry house—this

being close to the piggery. As poultry, however, are said to have a knack of flying into other people's pockets or bags, to prevent this catastrophe or loss to the cottager it would be better to have the hen-house near the cottage, and, if the yard be roomy enough, it will be well to erect it there, especially if the kitchen fireplace is towards the outside wall, thus giving warmth to the hens. Every cottage should have those two conveniences, as giving the labourer something to amuse himself with during his spare hours, and these cannot better be filled up than by adding to the food of the family. Everyone knows what "a fine variety of feeding" and picking there is in a pig, and those who know anything of France know well what can be made out of a well-stocked hen-house. Having now discussed sundry points connected with the accommodation of the cottage, we conclude this part of our subject with a few general remarks.

As to construction, we very nearly exhausted all there is to be said on it in this and other departments of the subject, in another part of the series, to which no reference is therefore made. It may be noted, however, that there are sundry points in which considerable economy may be effected. Thus, while the living room should be made as comfortable as possible, its floor boarded and its walls and ceiling plastered, there is no necessity for this class of work being done in the scullery, if the brickwork of the walls is properly and well pointed and covered with whitewash, and ceiling left open to the roof boards. This will be quite sufficient—indeed, it will be better so far as the roof is concerned; for, if a single story, the place can be easily ventilated—a point of some importance, as all the washing is done in it. To aid this important process, the scullery should have a small copper or boiler, but care should be taken to have this apartment just large enough for its own special work, and its finishing such as to be healthy, in no way making it a place attractive enough for the family to live in it, which too many will be sure to do, if its dimensions are at all large. The object of the scullery is to do the work which will keep the living room tidy, which alone must be the room in which the family take their meals and sit. No attempt should be made to give elaborate fire ranges or a separate brick oven for baking bread; all the necessities will be met by fitting up an ordinary Lancashire grate. This, even of the cheapest kind, is capable of doing all the cookery of the cottage, including baking, and, with the lowest expenditure of fuel; for simplicity and economy we know of no grate like it. To decorate the living room with oil painting and wall papers is simply throwing away money in a majority of cottages. If our builders knew, as a body, how the continental people get effects, beautiful yet simply elegant, by the cheapest of size colours, they would

not throw away the money they do by adopting what we have above indicated as the expensive process used here. All the iron fittings, as locks, bolts, hinges, should be of the simplest but strongest kind; and if the head of the house has any natural taste, he may make them attractive rather than the ugly objects they are by "picking them out" with paint, the colour of which should contrast with the colour of the door and window casings. In brief, everything connected with the fittings and finishing of the cottages should be in keeping with the class which inhabits them, capable of doing good, honest work, without any pretensions or assumption of superiority.

Strongly as we are inclined to advocate the ventilation of all apartments, we question the utility, and doubt the policy, of trying to ventilate cottages. So far as the admission of fresh air is concerned, by the making of special inlets, this is also throwing away time and money, for they would inevitably be stopped up, so inveterate is the dislike to fresh air which the class of labourers have. Generally speaking, they are so much in the habit of keeping doors open that fresh air, as a rule, is not much wanted during weather at all warm, or during the day. Ventilation may be confined simply in the case of new cottages to the ventilating chimney tube already described. Economy may be further studied by making the outside erections of wood, not only for the reasons named further on, when speaking of the improvement of old cottages, but also for this further reason, that the majority of working men have a knack, more or less decided, of working in wood, so that they are pretty sure to be able to keep them in good repair. There are few, however, but what will be able to knock up a very fair piggery and poultry house, and some will go the length of constructing a scullery, or the like, at the back. We have seen some very ingenious and very ably constructed additions to cottages made entirely by the hands of its occupier.

We now come to another important point connected with the cottage question—the repair of old structures. Much more could be done than has been in this direction if those connected with the property gave a fair survey to ascertain in what condition the old cottages really are. In the majority of instances, we venture to say that of a large proportion of cottages which are out of repair, their state will be found to be such, that, by the outlay of a comparatively small sum, better cottages may be obtained than are now frequently built *de novo*; for the work done years ago was infinitely superior to that of the present day. The result is that there are numbers of cottages, even more than a century old, the materials of which are at this day absolutely better than those found in cottages recently built; and all that has to be done, in the case of many of them, is more in the way of repair than that of absolute

reconstruction. By making the roofs waterproof, putting down new or patching up old flooring, and other work of this character, they may be rendered at least healthy and comfortable, if not possessing all the modern improvements connected with the arrangement of the apartments and their fittings.

Where the cottages are not so thoroughly old and done for as that their doom should be written in the words "down with them," their improvement divides itself into two branches: First, making defective work good; secondly, adding to, so as to rearrange the accommodation. In carrying out repairs, a word or two of caution may be useful. To paraphrase the French saying, there are repairs and repairs; so that it is necessary for the parties employed to carry them out to pay attention as to the class of work to be done under this head; for in some cases what is called patching is simply throwing away money, as it is impossible to make the newly put in materials take, so to say, kindly to the old—the result being that the patched part will in a short time be almost worse than it was before, and in such cases the best way is to take the old material wholly out, which will be best, and in the end cheapest. The fact is, repairing may be said to be a trade of its own, some having a remarkably clever knack of knowing exactly what to do, and of doing it thoroughly well; while others, although very clever at new construction, seem to be utterly at a loss at old. Generally speaking, the parts of old cottages requiring repair are the roof, floor, and window fittings. If the roof leaks are numerous and bad, a new roof covering throughout will have to be put on, the timbers being, as a rule, sound and good enough to be retained, as the builders of the old time put up the parts of heavier scantling than was necessary, while often good sound oak was used. Of roof coverings out of repair, the worst to deal with is that of thatch—not but that this material makes a sound and complete roof covering; but, where old and long neglected, it goes so thoroughly damp and rotten that the ordinary remedy is putting on either tiles or slates. While attending to the roof, the chimney or chimneys should be overhauled and put into thorough repair; and, if smoky, some attempt should be made to remedy the evil.

This brings us to the floor, which, although not in the same degree as a leaky roof, is often the cause of a great dampness and other discomfort in the cottage. In the olden times earthen floors were much used, but after long years of use they rapidly got not only worn unequally, causing hills and hollows of a most harassing kind, but so thoroughly dust and dirt imbedded that they were exceedingly unhealthy; but, worse than this, being in point of fact literally a continuation of the natural soil on which they were simply laid, and often on the same level as the

exterior ground, they became so saturated in various parts, if not, indeed, over the whole surface, that they might be said to be little better than outside soil. Other causes tended to make them approach this unhealthy state for an interior floor—such as slatternly housekeeping, or in the case of a single-storied cottage, the drip from a leaky roof. To attempt to repair a floor of this kind by simply making the surface uniformly level, which some seem to think is all that is necessary, is hopeless. The only way to deal with the case is to take out the earthen floor, and also the natural soil between it for some depth. Nor is it alone in the case of earthen floors that damp ones will be found, for, arising from one or other of the causes already named, the soil underneath tiled, brick, stone, or wood floors become so saturated with wet that damp is continually arising and finding its way into the house through the joints of the above-named materials; that these themselves get thoroughly damp. Where the expense can be afforded, the most comfortable kind of floor is a wood or boarded one, and where put down, care should be taken to see that the materials are placed at some distance above the natural soil, so that a clear space is left between the two—this being either left void or filled up with dry cinders, smithy clinkers, or coke, which will give a dry floor and also prevent vermin from finding a lodging. Floors of Portland cement concrete, which have been already described, will be found easily and cheaply made, and absolutely free from damp; but, like brick, tile, or stone, it gives a cold and comfortless surface in no way approaching the comfort of that of wood. However, by fixing in wood fillets before the concrete sets, and nailing the wood boarding to these, the best possible kind of floor can be obtained. But we fear the expense of this will be prohibitive of its use. But for superior houses nothing can excel this flooring for ground floors, at once absolutely damp and vermin proof, warm and comfortable.

Little need be said as to the window fittings, save that, in cases where they are thoroughly out of repair, the best way will be to give up all attempts at patching, and put in new casings, with glass panes of moderately good size.

We now come to the next step in the improvement of old cottages, namely, the giving of extra accommodation, many having nothing more than a room above and below, and in some cases, as that of a single-storied cottage, only one. In such cases all convenience for domestic arrangement is utterly out of the question. There are various ways of giving extra accommodation, varying according to circumstances and the amount of accommodation required. In the case of a single room, occupied by a married couple without children, or an old couple, much might be done to render the room more comfortable by the addition simply

of a porch to the exterior door; and, as in a majority of cases, such cottages are woefully deficient in conveniences for putting away household matters, the house may be rendered still more comfortable by giving corner cupboards and shelving wherever they can be conveniently placed. One convenience which adds very much to the comfort and orderly arrangement of a cottage is a place for washing dishes, or a scullery, should there be wall space between the exterior door and the window in front of the house; or if the external door be at its end at the porch, which we have recommended, be given, the dimensions of the porch might be so far increased that a small scullery may be made at one end of it, entering from the porch; and this also may be provided with shelving, as space may be had at one or other part thereof, or, in place of using the porch for this purpose, a small apartment at the back may be made in the form of a lean-to, the door entering from the cottage; this may be made large enough to contain, not only the scullery, but also a larder or pantry. This latter convenience is one of the greatest value.

In the case of a married couple, with two young children, the family with one room, as is not seldom all they have, is put to great inconvenience, especially for sleeping accommodation. Such an offset or "lean-to," of which we have just now described an example, can be made at very little extra cost, large enough for two young children to sleep in. Such extra accommodation, if properly gone about, will cost very little—much less, indeed, than most would suppose; what is wanted is space, the fittings being of the plainest character, and only such as to secure efficiency and comfort. For every addition of the sort it should be remembered, requires only three sides, the fourth being afforded by the original wall of the house.

The roof may also be made thoroughly weatherproof and warm, and yet be of the simplest character known as the lean-to or shed. Nor need even expensive covering be used, an excellent kind being obtained by the use of the asphalted felt. To make this covering thoroughly efficient, the overlap should be much wider than is usually the case, and the joint or edge be secured with a half-round wood roll, taking care to nail this to one and the same edge only of the board or plank which supports the felt. When the whole is thus put on, the surface should be covered with at least two coats of coal tar and sharp sand, the tar being first put on and the sand sprinkled over it. One coat should be allowed to dry before the second or third is put on. A roof made in this way, with the tar and sand coating renewed yearly, will last a very long time, and afford a very much more comfortable one than nine-tenths of the leaky roofs which disgrace the cottages in so many of our rural districts.

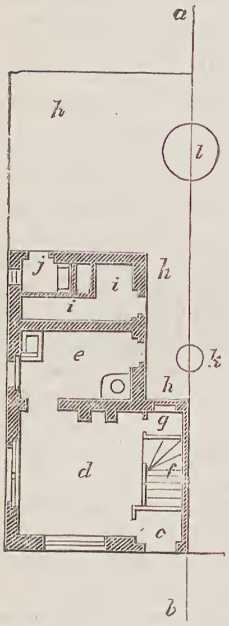


Fig. 149.

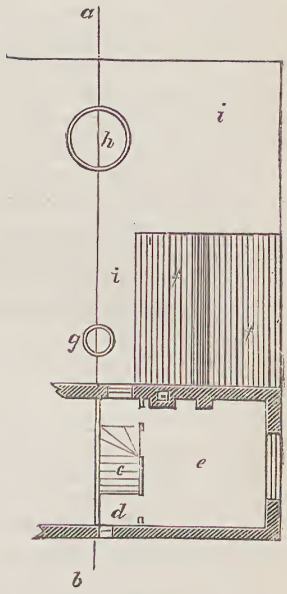


Fig. 150.

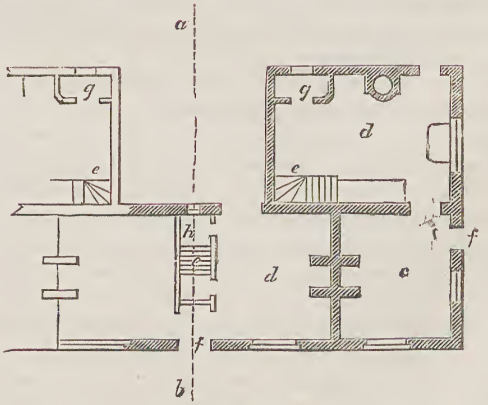


Fig. 151.

If these off-set apartments have boarded floors, these should rise at least the height of one step above the ground level. This may be an inconvenience, inasmuch as one would have to rise in entering from the living room or descend in coming into it. But this should reckon as nothing, when set against the great convenience of a floor not likely to be damp, an essential thing at least in the bed room.

If a larger amount of accommodation is required, some skill will have to be exercised in the planning, and very convenient arrangements may be more easily made by changing, in some cases, the position of the door, or, perhaps, the window of the original room. In the case of the additions made or required being considerable, it would, of course, be worth while to have an estimate made of the cost of a new cottage as against that of altering the old; but, as we are only considering the latter, we pass on to other points after merely giving the hint.

We give here a few representative plans, but, of course, it is obvious that we do not attempt to do more than suggest arrangements, which may be adopted in their entirety or modified to suit special circumstances. We may add that the plans are for the most part those of cottages actually built and approved.

In Fig. 149 we give the ground plan (half on centre line *a b*) of a semi-detached cottage, in which *c* is the porch, *d* the living room, *e* the scullery with copper or boiler in one corner and the sink in the opposite; *f* the stairs to upper floor, at end of which there is a small cupboard *g*. Entering the yard, *h h* is the outhouse, containing the apartment *i i* for wood and coal, and the privy *j*; *k* in the yard shows the position of well, *l* that of rain-water tank.

In Fig. 150 we give the plan of upper or chamber floor of this cottage (half only on centre line *a b*), in which *c* are the stairs, *d* a closet at end of same, entering from the bedroom *e*; *f f* shows the roof of outer buildings, as *e*, *i*, and *j* in Fig. 149, *g* being the position of well, *h* that of rain-water tank, *i i* being the yard.

Fig. 151 shows the half plan, on centre line *a b*, of an arrangement of cottages in which three separate ones are under one roof. Two of these have three bedrooms, and the third two bedrooms, in the upper floor shown in Fig. 152. In Fig. 151 two of the houses of the cottages are entered from the ends, the third from the centre. In the end house *c* indicates the position of the living room or kitchen, *d* the washhouse, *e* the position of stairs to upper floors, while *f* indicates that of the entrance door, which, as will be observed, give immediate entrance to the living rooms without the intervention of a porch. The washing houses, as *d* in the end cottages, have a boxed-off closet or pantry *g*, while this accommodation is provided to the central house at the end

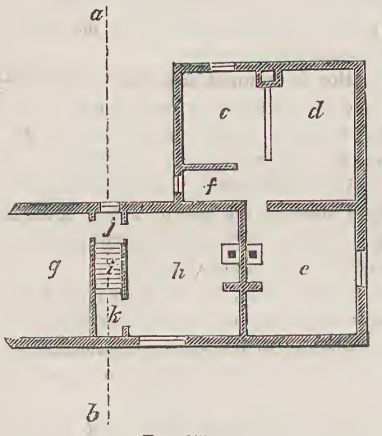


Fig. 152.

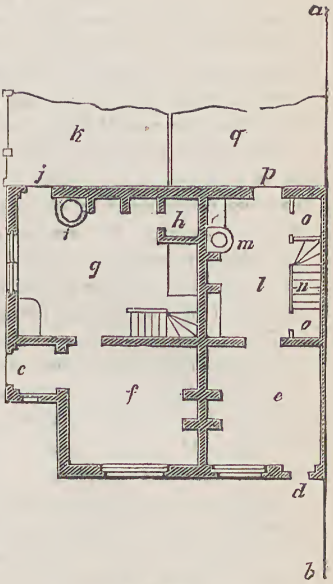


Fig. 153.

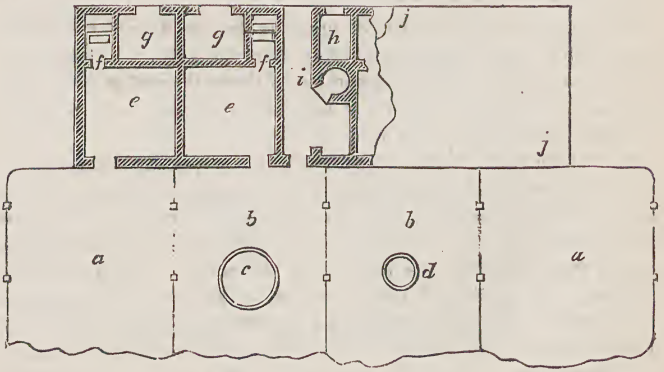


Fig. 154.

of the stairs *a*, as shown at *h*. In the centre house *f* is the entrance door, *d* the living room, *e* stair, *h* pantry.

In Fig. 152, which is the half plan of the upper floor, one of the end cottages is shown as having three bedrooms *c*, *d*, *e*; *f* being the position of stairs. In the central houses *g h* are the two bedrooms, *i* the position of stairs, *j* and *k* being the position of closets entering one from each bed room.

In Fig. 153 we give half the ground plan on centre line *a b* of an arrangement of cottages in which there are four under one roof; the end houses being provided with porches at the entrance doors, as at *c*; the centre ones having no porch to the doors, as *d*; but entering at once to the living rooms *e*. In the end houses *f* is the living room, *g* the scullery with a closet *h* and copper *i*; *j* being the back door to the yard *k*.

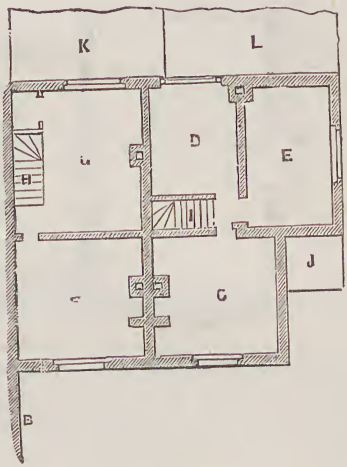


Fig. 155.

In the central cottage *e* is the living room, *l* the scullery, with copper *m*, *n* stairs leading to upper floor, *o o* closets, *p* back door leading to back yard *q*.

In Fig. 154 we give part plan of the outbuildings in which *a a* are the yards corresponding to *k*, Fig. 153, of the end cottages *b b*; the yards of the central cottages *b b* corresponding to *q*. In Fig. 154 *c* is the rain-water tank, *d* the pump, *e* wood and coal department, with privy *f*; the pigsties *g g*, and ashpit *h*. Entering from the back of the yards, *i* is one of the bakehouses, with which the central cottages are supplied, *j j* outline of the roof of outbuildings. In Fig. 155 we give the plan of upper chamber of two of the four cottages, an end and a central one, the centre line of the four being *a b*. As before stated, the end cottages have three bed rooms, as *c*, *d*, and *e*; the central ones having two only, as *f* and *g*. The position of stairs is shown at *h* and *i*, the roof of porch at *j*, the position of the yards at *k* and *l*.

All those plans are double or two-storied; but we give in Fig. 156 the ground plan of a single-storied cottage built on the estate of Lady Caroline Kerrison, in which two central cottages are bounded by end ones. In Fig. 156, *a* and *b* are the porches of end and central cottages, *b* the

living rooms, from which entrance is had to the sculleries *c c*, and small bedroom *d*.

We could extend these illustrations, showing cottage accommodation almost *ad infinitum*; but we must content ourselves with concluding what

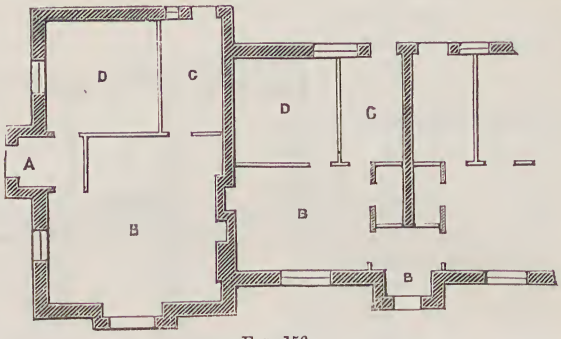


Fig. 156.

is therefore a very short series by giving an illustration of a Scottish cottage built on the estate of the late Lord Kinnaird, a nobleman who has done as much in this department of agriculture in the north as the Duke of Bedford has done for it in the south. The cottage here illustrated in

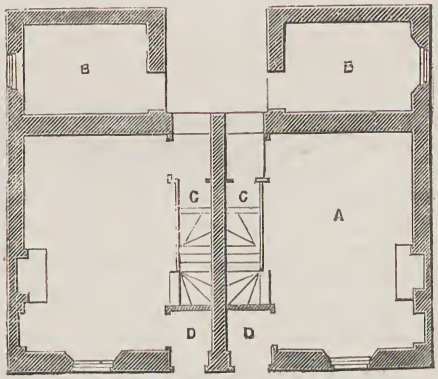


Fig. 157.

plan is of the class known as two-storied semi-detached, Fig. 157 being the ground plan, in which *a* is the kitchen (17ft. 6in. by 12ft. 6in.), *b* the scullery (11ft. by 7ft. 6in.), *c* a small pantry or closet at end of stairs, *d* the porch. In Fig. 158, which is the bedroom floor, *a* is the principal

bedroom (12ft. 6in. by 9ft. 6in.), *b* back bedroom (9ft. by 7ft. 6in.), *c* small ditto or closet (6ft. 6in. by 4ft. 6in.).

These plans may represent the superior class of cottage accommodation in the north; but it may form an illustration suggestive of more points than one connected with the subject of cottages, applicable alike to England and Scotland, if we give in conclusion a sketch showing a class of cottages but too common in the latter country. This being but of one story, and the accommodation consisting but of one room, as *a*, Fig. 159; the bed or beds, as *b*, being placed at one side, and confined within a space partitioned off from the room, and hence termed box beds.

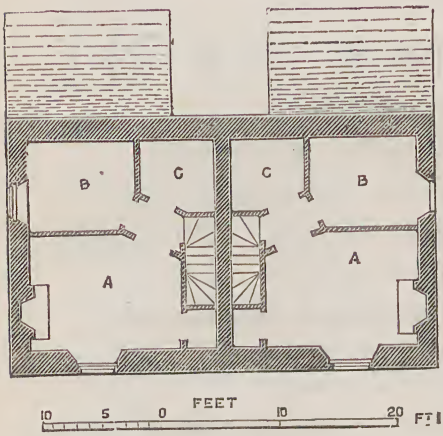


Fig. 158.

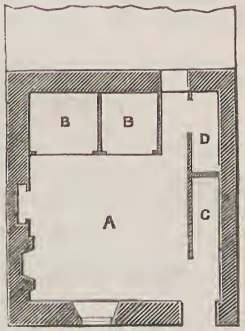


Fig. 159.

These spaces are sometimes provided with folding doors to conceal the beds during the day, sometimes left open in front. The other accommodation consists of a small closet, as *c*, partitioned off from the living room, in which coals, lumber, and various things are generally kept; to this is sometimes, but not always, added a pantry *d*. Cottages of this class—and not a few of the better ones—have no steps to raise them above the level of the almost universally undrained and damp ground, but enter at once from the level of the same—or even descend below this—and have also not unfrequently no door or entrance flagstone. All this is as bad as it can well be, and we mention it that it may be studiously avoided.

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